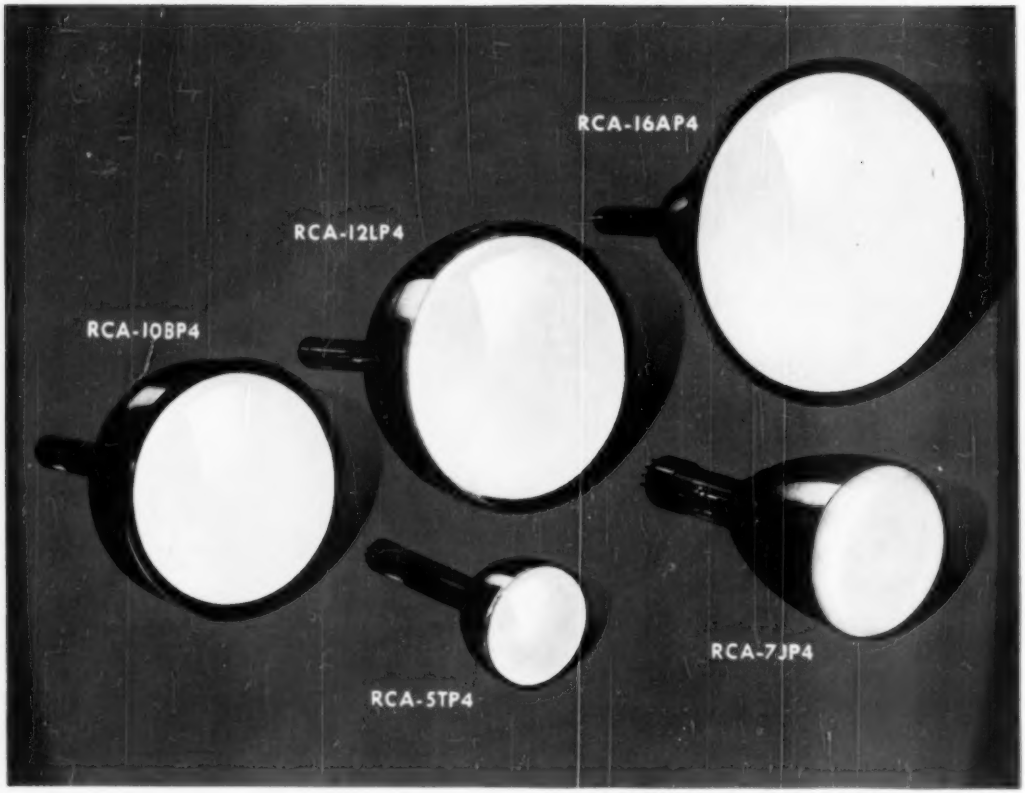
RADIO & TELEVISION NEWS

JANUARY
1950

COMMERCIAL AVIATION OPPORTUNITIES FOR RADIOMEN . . . PAGE 31



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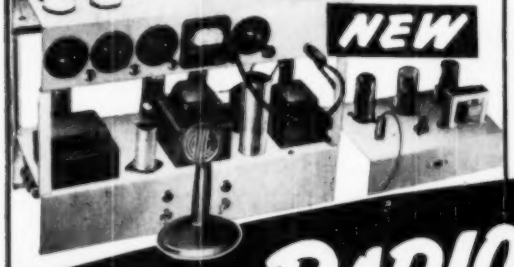

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VETERANS

GET THIS TRAINING WITHOUT COST UNDER G. I. BILL

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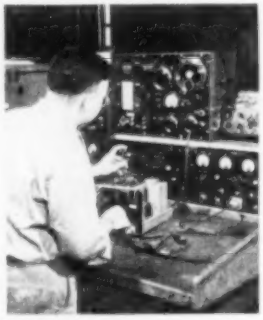

COVER PHOTO. F. J. Weisenberger, one of American Airline's radio technicians, checks a piece of radio gear before it is re-installed in one of the airplanes. (Kodachrome by Merle Oelke)

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CONTENTS — JANUARY, 1950

Aircraft Radio ..... James Holahan 31
Frequency Measurements for Citizens Radio ..... Harold McKay 35
Is Stratovision the Answer? ..... Kenneth R. Boord 36
A Crystal Receiver with Transistor Amplifier ..... Rufus P. Turner, K6AI 38
The Beginning Amateur (Part 12) ..... Robert Hertzberg, W2DJJ 40
A Two-Meter Quad ..... G. P. Oberto 43
Mac's Radio Service Shop ..... John T. Frye 44
Modern Television Receivers (Part 21) ..... Milton S. Kiver 45
Converting the TR-4 for 420 mc. ..... D. H. Rogers, W2MLF 48
Make Your Own Self-Generating Photocell ..... Guy Dexter 50
Eliminating Broadcast Interference Caused By TV Receivers ..... Jack Najork, W2HNH 52
Printed Circuits (Part 2) ..... John T. Frye 53
Dynaural Preamplifier Provides Wide Compensation ..... Hermon H. Scott 56
A Single Tube A.F.C. Circuit for TV Deflection Systems ..... John A. Cornell 58
A Versatile, Low-Power Transmitter ..... G. L. Countryman, W3HH, W1BBK 62
Improving Performance of Small P.A. Amplifiers ..... John B. Ledbetter 64
Oscillator and Gain Set for Audio Measurements ..... Hal Bumbaugh, W6HH 66
A Volume-Compensated Tone Control ..... Alan Schwan 70
A Handy TV Service Kit ..... Ralph E. Hahn 86
Oscilloscope Quiz ..... Ed. Bukstein 132

DEPARTMENTS

For the Record ..... The Editor 8
Spot Radio News 16
Within the Industry 22
Short-Wave ..... K. R. Boord 61
What's New in Radio 79
AFCA News 92
Letters from Our Readers 98
New Television Receivers 124
MARS 146
Manufacturers' Literature 150
Technical Books 156

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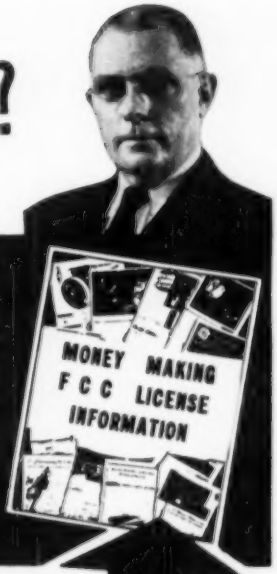

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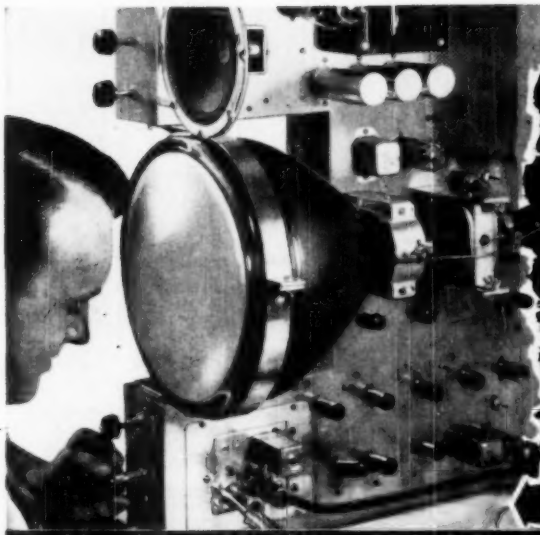

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For the RECORD.

BY THE EDITOR

IS TELEVISION GOING "MODEL T"?

THE past year lived up to all expectations, as far as television was concerned, with but one exception. Price cutting and competition found sets produced late in 1949 having all the earmarks of the "Model T Era." Circuits developed during 1948 were able to operate in fringe areas with good results. They were also capable of good audio performance. There was little skimping of parts to save a few pennies in production costs.

Engineers were left pretty much in charge of development and improvements, and their recommendations were accepted by the set maker. The result was quality merchandise, capable of trouble-free performance in the customer's home. Then came the price war. Dealers would make almost any deal that meant an easy sale and the disposal of a TV set. Sales slowed down and price cutting techniques swept the country.

Profits dwindled and to make a bad situation even worse, manufacturers looked for a solution in cheaper sets. Circuits were streamlined by eliminating tubes and components. Cheap audio circuits were employed and 69-cent speakers appeared in many consoles as well as table models. Acoustical requirements were shoved aside and six-inch speakers appeared in random locations—anywhere where space could be found.

Sound was projected in any old direction, much like a 1930 auto radio, and many TV sets of recent manufacture don't compare to prewar standards, either in performance or pleasant listening.

The public has been led to believe that FM audio, with its superb tonal range possibilities will provide the purchaser with response from 30-15,000 c.p.s., but when facts rear their ugly heads we discover that many of the TV programs sent over the networks pipe the sound through regular AM lines with highest frequencies around 8000 cycles.

So why all the ballyhoo about "high-fidelity sound" in TV sets? The trend in modern television design has been to decrease manufacturing costs in order to increase the volume of receivers purchased by the public. Although this abbreviation in cost has served the purpose of bringing entertainment into the home of Mr. Average American, one salient fact sticks out like the proverbial "sore thumb." Little is, apparently, being done to produce *better* television receiver design. Engineering along video lines is being regimented to produce the same thing or something that will pass for less money, instead of serious thought being directed toward better operation.

This has resulted in numerous short cuts in receiver design, all of which have degenerated television engineering, and have put the technician service depots and honest dealers in quite a dilemma. Practically no manufacturer is immune to this charge. There seem to be but few producers of television receivers willing to hold fast and buck the commercial debauchery which has placed television, a lush promising new industry in both the technical and entertainment fields, into the chiseling price-cutting bracket in which it is to be found today.

Effort is being expended on fooling the public with indoor antenna gimmicks, guaranteed to work better than the old reliable antenna, quick adaptability to the ultra-high frequencies, color and a host of other hoaxes, but apparently no effort is being directed toward improving what we have attained up to 1948. There is no denying the fact that we must have "cheapies" since not everyone can afford an investment of several hundred dollars, but let's have some real good television receivers too. Automobile manufacturers know that a really fine car will always be in demand by those wanting "something better."

THE year 1950 promises to be a very lucrative period for the television service technician. As a matter of interest it is estimated, for example, that during 1949 TV servicing accounted for approximately $90,000,000 in installation and service charges, another $22,500,000 in antenna sales, and a further $20,750,000 in accessory sales. This totals over $132,000,000. It is predicted that this figure will be greatly exceeded during 1950 as new markets open up throughout the country.

We have been hearing rumors that radio will soon be obsolete. We don't share in that belief. As a matter of fact, radio production of receiving sets for 1949 was a bit over 10,000,000 as against 2,500,000 television sets. In many remote areas dealers haven't been supplied with enough AM to meet demand.

According to *Television Digest*, Max Balcom of *Sylvania* forecasts a 3,750,000 TV set production in 1950, and that's a lot of television. Yes, 1950 will also be a television year, and the dealer and service technician have much to look forward to as many new markets open around the country. We hope you get your share.....O.R.

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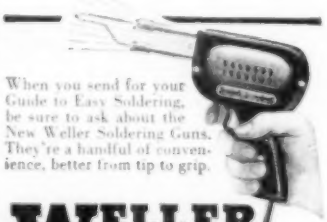

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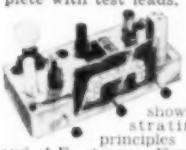

SIGNAL GENERATOR

You construct the Transitron Signal Generator shown here, demonstrating Transitron principles in both R.F. and A.F. stages. You study negative type oscillators at firsthand.

AUDIO OSCILLATOR:

An electronic device, which produces audio-frequency signals for modulating R.F. (radio frequency) carrier waves, testing A.F. (audio frequency) amplifiers, speakers, etc.

T.R.F. RECEIVER

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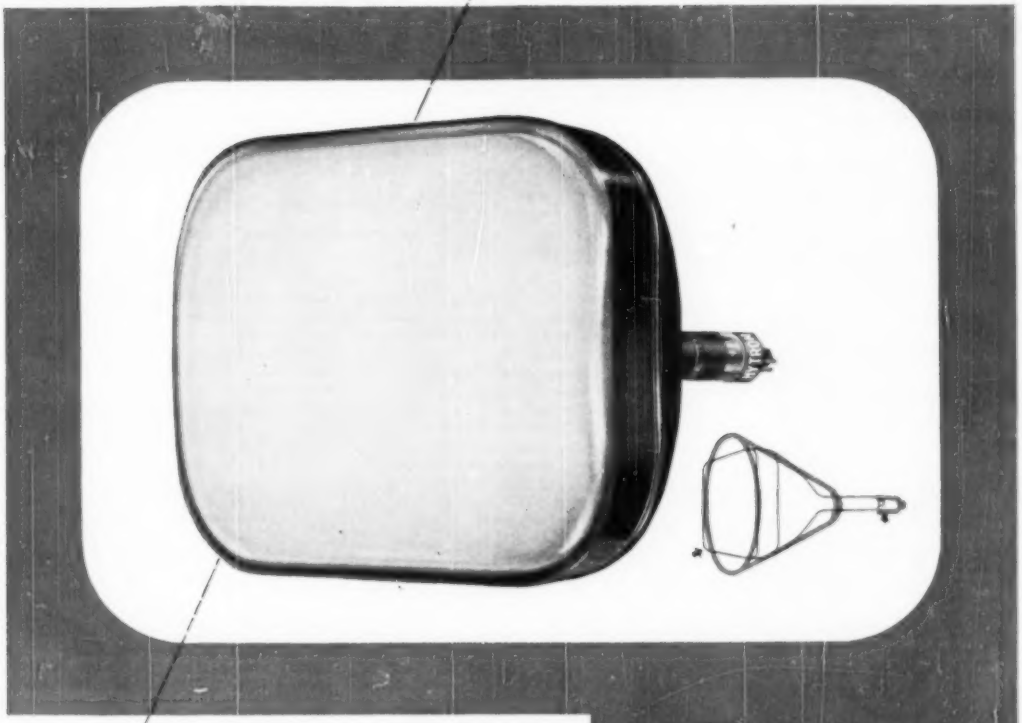

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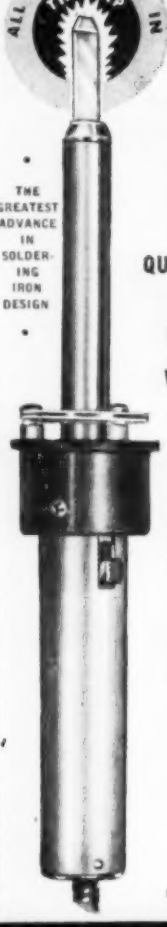

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Spot Radio News

** Presenting latest information on the Radio Industry.*

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

TV, still enmeshed in the most sizzling battle of words in technical history, has now entered the roaring phase of the fury with operation CD and CCD at hand. "Operation CD" or color demonstration covering all available systems began in the early fall and "Operation CCD" or comparative color demonstration, was scheduled to begin as this column was being prepared.

The CD days were riotous ones with invectives bouncing all over the crowded hearing and look-in ballrooms in uptown and downtown Washington, where the tests were held. There was substantial evidence that the look-and-see-what-we-have days would be exciting when the FCC prepared its notice covering the procedure *CBS* would follow during its trial moves.

Said the notice: "On this day camera equipment, color television receivers, monochrome receivers, and converted monochrome receivers will be demonstrated. The receivers to be demonstrated will include four receivers receiving color only in 6 megacycle channel width, one receiver for demonstration of 6 megacycle color versus wider channel color off-the-line, one conventional black and white receiver converted for color reception and probably one combination black and white receiver. . . . The demonstration will be divided into seven sections: Introduction, image brightness and flicker, compatibility, color breakup and fringing, image registration and definition, including tests over a coax cable of 2.7 megacycle bandwidth and over radio relay circuits of 4 megacycle width, ghosts and noise, and color fidelity and camera light sensitivity. . . . In these demonstrations, program material will include slides and test patterns, dancing, singing, juggling, fashions, near and far shots, different types of lighting and backgrounds. . . . In one demonstration the camera equipment will be located at a local high school football field."

The tests were quite impressive, with the Commissioners and over one hundred and fifty industry representatives looking on at the Hotel Carlton ballroom. Particularly interesting was the first attempt to try a remote pickup of the football game from the Woodrow Wilson High School field. Although the skies were overcast and there was even a heavy rain during the final moments of play, the results were comparatively satisfactory.

Much of the equipment was basically similar to that displayed in '47. There were, however, available this time, special converters for black and white receivers. These were quite large and consisted of an enclosed spinning disc, speed control, and glass-type enlarger, which could be slid into position.

Several days after the *CBS* show, *RCA* presented their version of color TV with an all-electronic system, the operation of which was described by your correspondent in a previous report. This demonstration originated in the *NBC* studios at WNBW in the Wardman Park Hotel. Employed were two cameras for live subjects in the studio, one camera for color motion picture film and one camera for color slides. In the control room were two color monitors and a control-room console, plus a specially-built sixteen-inch color receiver. The color camera was equipped with three separate tubes, each equipped with a color filter to receive the three primary colors—red, blue, and yellow. The receivers were large, requiring three picture tubes arranged to transmit images to dichroic type mirrors and then to a viewing screen.

The program was very elaborate and ranged from solo performances by network favorites to a musical display by a nineteen-piece orchestra, all attired in brightly colored costumes.

Some of the results were satisfactory and others disappointing, *RCA* engineers indicating that there were quite a few *bugs* still to be ironed out before consistently perfect performances could be provided. The degree of compatibility displayed by this system in monochrome reception of color signals on standard TV models impressed observers.

Tests were held by *RCA* during the entire week and as the days passed on, some of the pickup problems were solved and the pictures improved considerably. In fact, when one of the later demonstrations was viewed by Senator Edwin C. Johnson, chairman of the Senate Interstate and Foreign Commerce Committee who sparked the color TV investigation, the Senator appeared quite pleased. He commented

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AF Voltage
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that he was indeed surprised at the reproduction, predicting that the *RCA* method appears to have some very vital acceptance features.

During a subsequent review of the color situation, the Senator revealed that side-by-side tests would permit the Commission to determine just what type of standards we should have and as a result, within a year, we could have color TV on the air. When queried about the survey results collected by the impartial TV color committee the Bureau of Standards set up at his request, he replied that their report would not be submitted until the conclusion of the color hearings. The Senator told FCC Commissioner Robert Jones that the findings of this committee would " . . . sustain the position of those Commissioners who do not have a closed mind on color TV and will make impossible again the FCC action in the last hearing, when it shut the door on television progress."

In another statement on standards, the fiery Senator emphasized that the Commission should not decide in an arbitrary manner as to the virtues of any particular system. Instead, he said, they should set up a flexible type of standard which would permit the art to develop in the customary manner of all American industry.

THE DEMONSTRATIONS apparently piqued representatives of *DuMont*, who have contended that color TV is still in its breadboard stage, and a few days after the two color shows, they put on a demonstration that will be remembered for years and years. With a specially constructed 700-pound mechanical-type adapter, six and a half feet long, four and a half feet thick and four and a half feet high, and a separate generator and motor, the boys from *DuMont* presented their version of the equipment required to convert a twenty-inch tube set for color reception at present. When the huge four-foot color wheel, speeding at a rate of 210 miles an hour began to spin, and a fuse blew because of the load, FCC Headman Coy became riled and roared at Dr. Goldsmith, conducting the test, to stop the test which he called a "sideshow." Commissioner Frieda Hennock also blasted Goldsmith, citing the *demonstration* as one of ridicule and completely unfair to *CBS*. She pointed out that *Columbia* at no time stated that its system could be used for receivers having tubes larger than 12½ inches. An adjournment followed the abrupt halt and when the recess was over, only Commissioners Jones and Sterling were in their seats. With permission to continue the show, Goldsmith set the cumbersome affair into motion. Explaining the purpose of this admittedly noisy and complex setup, Goldsmith said: "We just got sick and tired of all the claims about easy conversion of present receivers to *CBS* type color and decided to show folks how ridiculous such conversions really are."

CBS attorney Richard S. Salant eyed Goldsmith and accused *DuMont* of setting up ". . . a publicity gag at considerable expense."

At the conclusion of this circus, Commissioner Hennock resumed her tirade against *DuMont* and asked Dr. DuMont how many of the deluxe 20-inch receivers, like the type he had used in the test, were in use. Dr. DuMont explained that while the model used was a $2500 type, the same unwieldy assortment of apparatus would be required for any 20-inch type set, many of which are selling for $500 or less. And incidentally, he added, *DuMont* is currently producing about 10,000 such models a month.

During one of the sessions, when Dr. Goldmark of *CBS* appeared on the stand, the question of projection was raised by Ed Wheeler, counsel for RMA. He asked Goldmark why the FCC had not been shown any projection type sets by *CBS*, and Goldmark smiled, and said quite frankly: "I was ashamed of our projection tests, but after seeing its performance with other systems *(apparently referring to RCA)* I feel it was not too bad."

The tests did little to clarify the basic issues and FCC decided to probe a bit deeper by requesting that the three color developers submit receivers to the Commission's laboratories at Laurel, Maryland for test. This edict brought forth a storm of protest, even from *CBS* who claimed that its equipment was on tour with the medical conferences and it would be difficult to alter that program. *RCA* indicated that it would probably send its receivers, although they felt that the equipment hadn't been sufficiently developed to warrant a full-scale intensive viewing test.

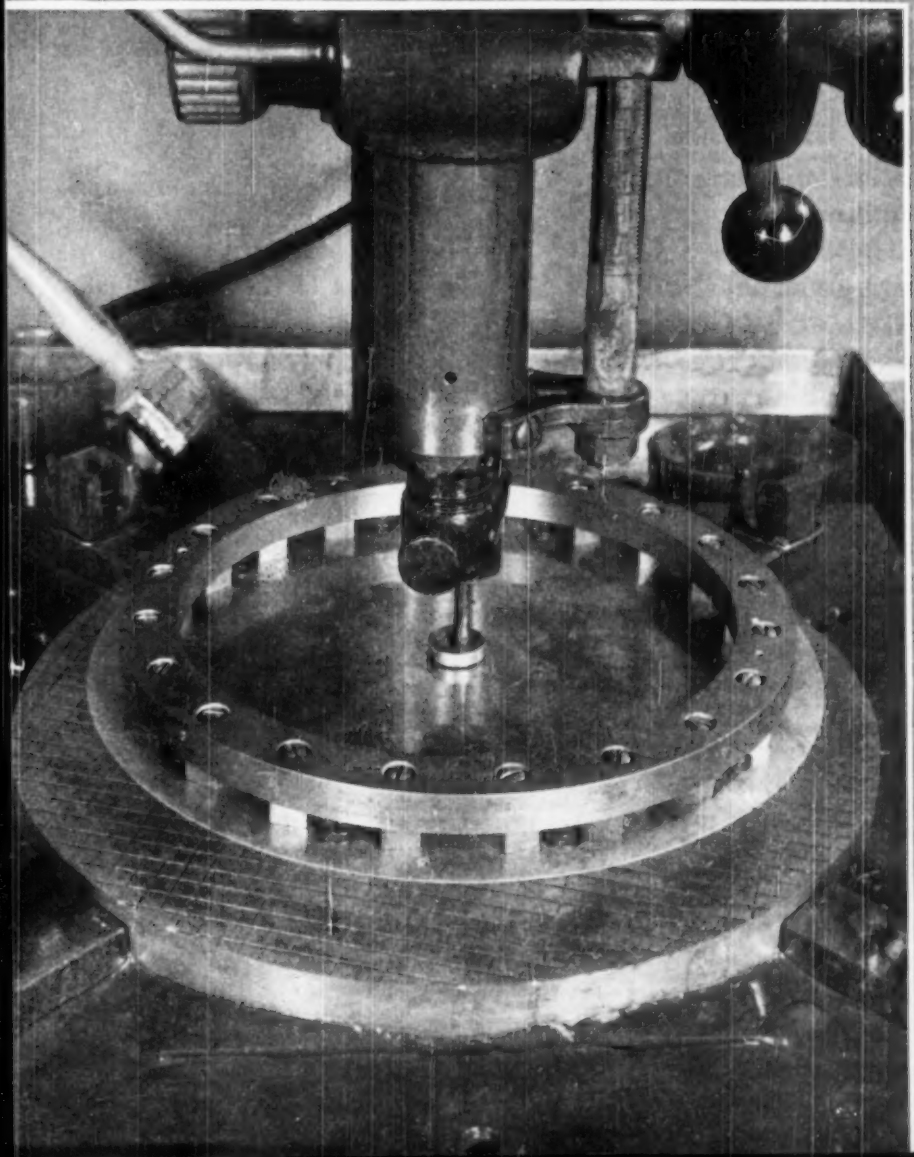
Shortly after the Laurel request was fired at industry, FCC hit the color boys with another test shell. This time they said that they wanted to hold a series of comparative tests within a few weeks in Washington. *RCA* revolted at this demand and raced a healthy reply to FCC, stating in part that ". . . The only purpose of demonstrations, comparative or otherwise, is to demonstrate to the Commission the principles and operating characteristics of the color systems which have been proposed. If a comparative demonstration is to be held and is to accomplish its purpose, the demonstration must be made with apparatus which will fairly reflect the principles and operating characteristics of the various systems, must provide an opportunity for the parties to demonstrate their systems with comparable types of receivers and must provide an opportunity for all proponents of color television systems to demonstrate their systems simultaneously. . . . Unless these basic requirements are met, no useful purpose will have been served. To conduct comparative demonstrations on any other basis would not provide a fair hearing to the parties con-

(*Continued on page* 135)

JANUARY, 1950

RADIO & TELEVISION NEWS

RADIO-ELECTRONIC *Engineering*



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KLYSTRON POWER SUPPLY AND SQUARE WAVE MODULATOR ..... Samuel Freedman 3

HIGH IMPEDANCE D.C. VOLTMETERS ..... Edwin N. Kaufman 7

V.H.F. TANK DESIGN ..... B. E. Parker 8

RUGGED ELECTRON TUBE DEVELOPMENT 10

BRIDGE-BALANCED D.C. AMPLIFIER ..... G. A. and T. M. Korn 12

AUTOMATIC ANTENNA PATTERN RECORDER ..... Harry L. Gerwin 14

MEASUREMENT OF STUDIO AND ROOM ACOUSTICS ..... David Fidelman 16

SENDING END IMPEDANCE OF UNIFORM LINE 32

DEPARTMENTS

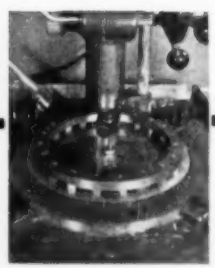
NEW PRODUCTS 22

NEWS BRIEFS 24

NEW TUBES 26

TECHNICAL BOOKS 28

PERSONALS 29



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COVER PHOTO—Courtesy of National Bureau of Standards

Pentagonal block apparatus developed at NBS for producing quartz oscillator plates thin enough for high frequency use. Twenty pentagonal blocks, rigidly attached to a steel ring, are shown resting on crystals (not visible) in corresponding nest openings.

This equipment provides a square wave d.c. output for feeding a reflex klystron microwave generator.

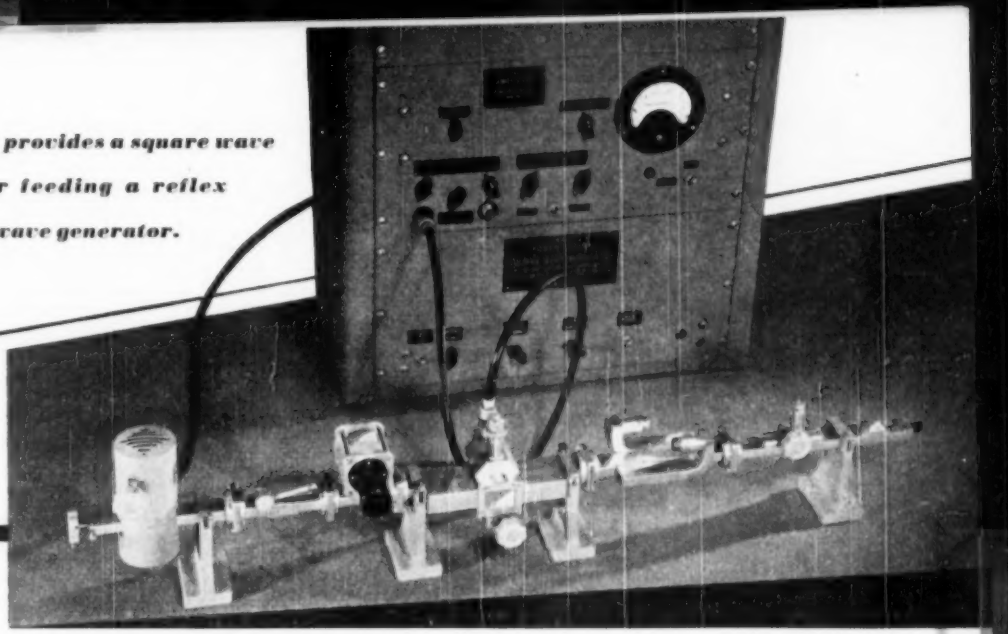


Fig. 1. Bench test setup including the power supply and square wave modulator along with various microwave equipments.

Klystron Power Supply And Square Wave Modulator

By SAMUEL FREEDMAN

New Developments Engr., DeMornay Budd, Inc.

MICROWAVE test and evaluating setups including the field of microwave spectroscopy commonly depend on tubes employing velocity modulated electron beams with repeller electrodes known as reflex klystrons for microwave power source. Such tubes are employed instead of conventional types because of the effect of the inductance in connections and the fact that the transit time is comparable with or in excess of the period of oscillation for the latter.

Any velocity-modulated tube or so-called "klystron" derives a radio frequency intensity-modulated current for operating an output circuit. Instead of dependence upon the number of electrons, the power is dependent on the changes in the velocity of the electrons with respect to each other. In what would be the cathode-grid region of a conventional triode, the following is provided:

a. The cathode emits electrons when subjected to sufficiently high temperature just as in the case of a conventional tube.

b. Two closely separated grids connect to a resonant cavity which is kept highly positive. Their separation forms an r.f. gap. The region between the cathode and this r.f. gap may be called a cathode-anode region in which the electrons emitted by the cathode receive their d.c. acceleration.

c. The r.f. gap subjects these electrons to an oscillating or r.f. field. This field alternately slows down or speeds up the electrons to produce velocity modulation.

d. A drift space beyond the r.f. gap permits the electrons to continue travel until they come under the influence of a "repeller" or "reflector" which is biased negative with respect to the cathode and much more so with respect to the r.f. gap and its associated cavity.

The acceleration or deceleration of the electrons in traversing the r.f. gap causes each electron to have a different speed beyond that point. This results in the bunching or grouping of the electrons. The more an electron is accelerated in traversing the r.f. gap, the further it can travel in the direction of the negatively charged repeller electrode before being reflected back in the direction of the r.f. gap. On the initial trip through the r.f. gap, as many electrons speed up and gain energy from the r.f. field as are slowed down and give up energy to the same r.f. field. They balance to zero. However, when the electrons are repelled back by the repeller, they are bunched. In returning to the r.f. gap, with the proper phase relations based on correct values of beam and repeller voltages, they can be made to give up energy. The amount of useful power between zero and maximum for a stated tube depends entirely on the correct phase relations of the oscillation which in turn depend on the availability of the proper potentials derived from a power supply.

If the tube transit time conditions are met and there is sufficient d.c. beam current to compensate for load losses and circuit power dissipation, the tube will oscillate and deliver power. The transit time depends upon the reflector voltage and the beam voltage. This results in oscillation and useful power for certain values of voltage and none for others. Each set of voltages resulting in power conditions is known as a *mode*. A dominant or more efficient mode will always exist for a particular tube at a particular frequency. The availability and utilization of this mode is dependent on the power supply voltages necessary to energize the tube being readily available.

In microwave test setups the amount

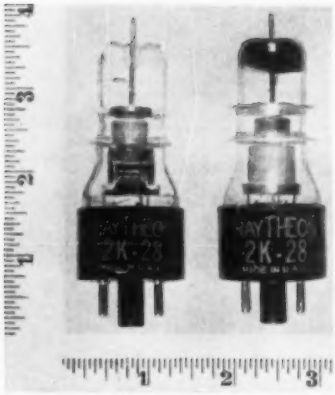


Fig. 2. Two views of the type 2K28 reflex klystron.

of power required is sufficiently low to permit operations even with low tube efficiency, such as operation at one of the less efficient modes of the reflex klystron. A few milliwatts are normally sufficient in most cases. In many setups, an attenuator capable of providing attenuation of 10 to 30 db. is placed between the signal source and point of measurement to assure stability of measurement. As little as 10 to 25 milliwatts may be used. In some cases, systems have been tested with a few hundred microwatts, or even less.

The reflex klystron type of tube normally used in this work differs from other types of klystrons in that it is a single-resonator instead of a multi-resonator type. The electron beam passes once through the resonating cavity and then encounters a negative electrode which causes the electron to return through the cavity on a second transit at which time useful power is developed. The reflex type of tube may have its resonant cavity within the enclosed vacuum envelope or it may employ an externally attached cavity for the type of tube illustrated in Fig. 2. In the latter case, as for the Type 2K28, a cavity encompasses and electrically connects to the copper fins extending through the glass seals.

Most of the conventional reflex klystron tubes operate at a beam voltage of 300 volts and a beam current averaging about 22 milliamperes. The repeller voltage is applied to an electrode which normally draws only a few microamperes of current. Modes of oscillation where any reflex tube does and does not function occur in the range of reflector voltage from zero to over 300 volts negative with respect to the cathode. In the case of the 2K25 tube, at least four or five modes can be developed depending on the range of voltage available from the power supply and the construction of a particular tube. In other cases such as the 726 or 2K29, less modes can be developed. In the case of the 2K50 tube which has been produced in limited number but for which a demand exists for resumption of production, despite the much higher frequency (1 centimeter region), fine tungsten grids for the cavity gap permit larger beam and shorter transit distance through the gap. This tube requires more critical adjustment of potentials and a power supply must have special or additional provisions to meet this requirement. Optimum reflector voltage varies from tube to tube of the same type as much as plus or minus 30 volts.

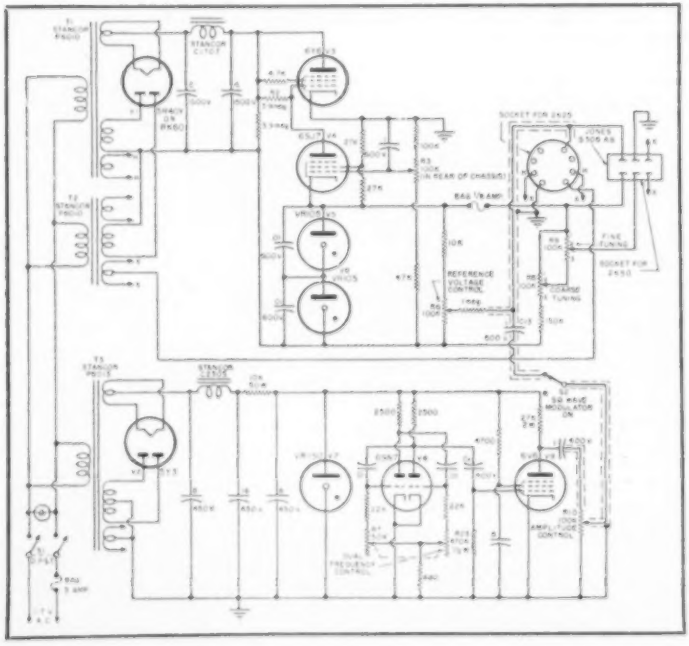
Two tubes of considerable interest because of their availability in quantity at low cost in the postwar surplus market are the types 2K28 and 2K25 for the 10 and 3 centimeter bands respectively. The following data is based on the *Raytheon* Velocity Variation Oscillator (their name for the reflex klystron). Fig. 4 describes various electrical characteristics for the type 2K25 tube versus changes of negative repeller voltage. Fig. 7 describes additional data versus frequency and changes in resonator potential. The power output changes about 1½% per volt change in resonator potential.

Heater requirements are 6.3 volts a.c. or d.c. at .44 amperes. The maximum ratings are 330 volts d.c. for resonator or shell voltage, 0 to −400 volts d.c. for repeller voltage range, 32 milliamperes d.c. for cathode current, 45 volts d.c. for heater-cathode potential difference and a frequency range of 8702 to 9548 mc. Power output varies from 20 to 33 milliwatts.

Fig. 6 shows graphs for the 2K28 comparing repeller voltage range versus change in wavelength. The frequency of this tube is determined by its resonator geometry. The complete resonator consists of two gold-plated copper discs and an external cavity which makes contact to them. The cavity used with the tube should have a dimension of .4 inch and should grasp an outer annular ring of 1/16". Maintaining proper cavity dimensions is important in that the cavity is usually made of brass and has a relatively large expansion coefficient compared to the glass between the two discs. By contacting the outer edges of the discs most of the movement caused by expansion will be taken up by the flexing of the copper discs without placing undue strain on the copper-to-glass seals.

Heater requirements for the 2K28 call for 6.3 volts a.c. or d.c. at .65 amperes. The maximum ratings are 300 volts d.c. for the grids, 45 milliamperes d.c. for cathode current, 0 to −300 volts d.c. for repeller voltage, 45 volts d.c. for heater-cathode potential difference and 1200-3750 megacycles for the frequency range with suitable

Fig. 3. Circuit diagram of the power supply and square wave modulator.



cavity. The tube is rated at 115 milliwatts output in the frequency range 3400-3600 megacycles with 250 volts d.c. on the grids, 20 milliamperes d.c. cathode current and −170 to −300 volts d.c. repeller voltage when operated on the 4th mode. When operated with 300 volts on the grid, this changes to 30 milliamperes d.c. cathode current, −155 to −290 volts d.c. repeller voltage on the 4th mode, 140 milliwatts power and frequency range still 3400-3600 megacycles.

In addition to special power supply requirements for these tubes, there must be modulating provisions of the microwave signal source in order to permit demodulation later by means of a crystal detector. Amplitude rather than frequency modulation is necessary. There are two methods normally used for AM. These are the sawtooth and the square wave. The square wave form of modulation is normally used because the sawtooth type has a marked FM component in the output of a klystron. Square waves will have a much lower FM component and it will not distort the readings. FM particularly cannot be tolerated if the energy is to be detected on a standing wave detector since the maximas and minimas will not fit the frequency and will create confusion. Reflex tubes are modulated by applying the square-wave signal to the oscillator repeller. FM is minimized by using a square wave with sufficient amplitude so that the oscillator drops out of oscillation for alternate half cycles, provided this be done below a limit where the tube is not driven into the next lower mode of oscillation.

Fig. 5 is the front panel view of a power supply and square wave modulator developed to meet the requirements of properly energizing and modulating the reflex klystron type of tubes. It is widely used in the microwave art by schools and laboratories for the so-called low voltage type of reflex oscillators described here. It is similar to the TVN-7BL unit used by the MIT Radiation Laboratory during World War II but is now known as the Type DB-407 from commercial sources. Fig. 3 is the complete circuit diagram including part values. Fig. 1 shows the unit mounted in a rack with a companion amplifier to furnish energy indications. In a typical application, working with a microwave bench test setup of fabricated wave guide components, a power cable leading from the back of the power supply and modulator unit energizes and modulates a tube such as the 2K25 located within a shielded and ventilated tube housing. In the Fig. 1 setup, the output is fed through the following components when viewed from left to right:

a. Tube mount for the Type 2K25

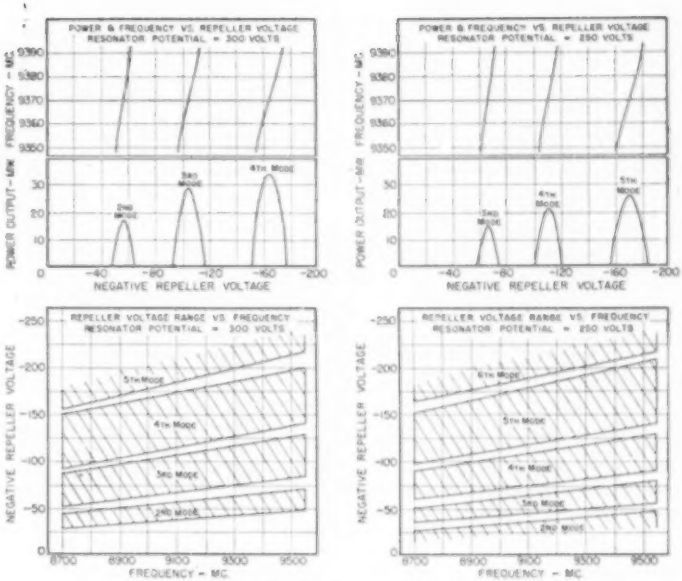


Fig. 4. Electrical characteristics of the type 2K25/723A/723B klystron oscillator.

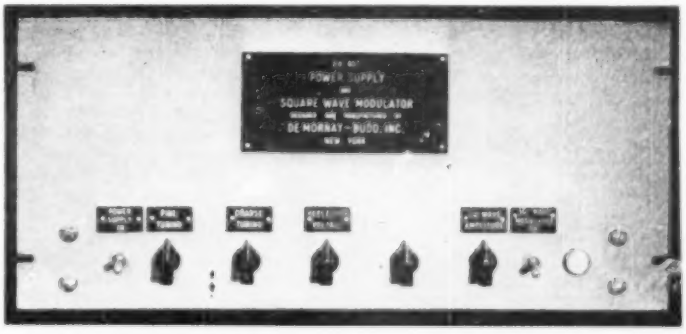
tube. The tube supply and modulator voltages are fed into the tube mount via an octal socket. The tube's antenna extremity protrudes into a wave guide forming part of the over-all assembly. A tunable back plunger is provided for terminating the wave guide with an adjustable short. A knob on the ventilated tube shield is used to vary the physical dimension of the klystron for tuning purposes. It controls the tuning screw on the tube to change position of tuning bows which are part of the tube's physical construction.

b. Flap attenuator for padding purposes. A hinged attenuator strip is made of carbon coated bakelite. The position of this flap can be varied, thereby permitting the strip to be inserted any desired depth into the wave guide. The attenuation will increase with increasing depth of penetration. The unit illustrated is designed for a maximum of 10 db. attenuation.

c. Frequency meter of the absorption cavity type. The cavity size is varied by a movable plate to resonate at any frequency throughout its operating range. It is moved by a micrometer with engraved calibrations on the micrometer barrel. These calibrations can be converted to frequency or wavelength by referring to the calibration charts furnished by the manufacturer.

d. Standing wave detector for measuring amplitude and phase conditions within the wave guide system. A silicon crystal detector or a bolometer (which may be a 1/200 ampere *Littelfuse*) connects from the moving probe traveling in the wave guide slot. A coaxial cable connects from the detector to a tuned amplifier to furnish an indication on the meter.

Fig. 5. Front panel view of the square wave modulator.



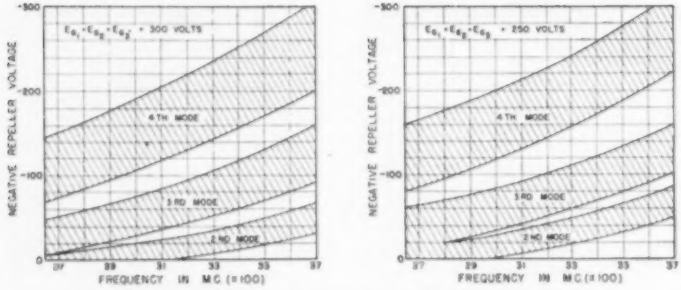


Fig. 6. Repeller voltage range vs. wavelength for type 2K28 tube. The exact value of repeller voltage producing maximum output at a certain frequency will vary somewhat from tube to tube, but the voltage for all tubes will fall within the shaded area indicated for each mode.

e. An optional bi-directional coupler in which samples of energy traveling in both directions in the wave guide are taken from the primary or main wave guide line by two auxiliary wave guides. It provides a means for measuring actual wave-guide power propagating in either or both directions at low power levels without disturbing the main transmission line. These may be taken off at the coaxial connections leading from the auxiliary guides.

f. Power termination and variable stub tuner. The power termination terminates a wave guide in its characteristic impedance and dissipates all of the microwave energy incident to it. It is a dummy load to provide practically reflectionless impedance match. The variable stub tuner further serves to vary the impedance in phase and magnitude to the optimum value.

The DB-407 power supply and modulator described in this article draws 80 watts from 115 volts, 60 cycle, single phase source. It delivers 6.3 volts at 2 amperes for heater and −300 volts for cathode as well as −300 to −450 volts d.c. for repeller requirements. When used with the 6-prong socket in the case of the 2K50 tube, there is also provided control triode voltage of −300 to −350 volts. The square wave modulator has a frequency range of 500 to 2000 c.p.s. The amplitude of the square wave is 0 to 100 volts peak to peak.

Referring to Fig. 3, the main power supply functions from the two transformers T_1 and T_2 and a full-wave rectifier V_5. It is separate from the square-wave modulator power supply, which functions from the transformer T_3 and the full-wave rectifier V_6.

Control of the output voltage of the main supply is accomplished by tubes V_3 and V_4. V_3 acts as a current-regulator tube, its grid voltage being determined by the plate current of the 6SJ7 (V_4) flowing through the bias resistor of that tube. The resultant increase of the drop in R_7 changes the grid voltage of the 6Y6 (V_3) negatively. For a given current delivered to the klystron cathode, this change in grid voltage must be balanced by an increase in the drop across the 6Y6. With proper circuit adjustment, this restores the output voltage to its original value.

The voltage which appears at the grid of the 6SJ7 is the difference between a positive voltage, taken from a voltage divider across the output voltage, and the fixed negative bias provided by tubes V_1 and V_2 voltage regulators. The constant bias provided by these regulator tubes, including especially the independence of this bias on the 6SJ7 plate current, is essential to the operation of this system. Adjustment of the bias, by means of the variable resistor R_{11} provides the means of adjustment of cathode voltage for the klystron. This resistor is set and locked at −300 volts. The regulated reflector voltage is obtained by tapping off from a voltage divider R_8 placed across the two voltage regulator tubes.

The voltage supply for the square wave modulator is regulated by tube V_7 (VR150). Tube V_8 (6SN7) and its associated circuit form a conventional multivibrator consisting of a two-stage resistance-capacitance coupled amplifier with the output leads of the second stage connected to the input leads of the first. The dual adjusting control of the grid returns R_9 adjusts the frequency of operation. In order to prevent the load from affecting the multivibrator frequency, the output voltage is taken from a buffer amplifier tube V_9 which is excited by the multivibrator.

Sequence of operation is as follows:

1. With chassis grounded, connect the unit to klystron tube with the appropriate cable.
2. Turn square wave modulator switch to "ON" position.
3. Adjust all panel controls to central position.
4. Turn power supply switch "ON."
5. After 5 minute warm up, tune reflector voltage for maximum output of the tube as indicated on the meter.
6. Adjust square wave amplitude for maximum output.
7. Tune square wave frequency for maximum response. The setup is then ready for operation.

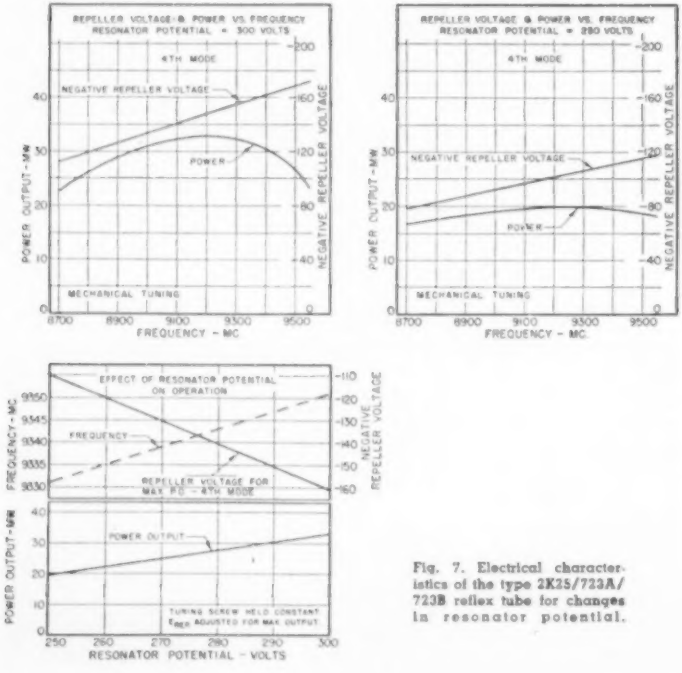


Fig. 7. Electrical characteristics of the type 2K25/723A/723B reflex tube for changes in resonator potential.

HIGH IMPEDANCE D. C. VOLTMETERS

By

EDWIN N. KAUFMAN

(Left to right) A "Tusite" octal header, a hermetic glass bead, a type 5803 tube, and interior and exterior views of a probe such as that shown in Fig. 2. Next is a 50,000 megohm resistor, a type 5803 electrometer tube and a very small probe.

Input impedances of the order of 10^{12} ohms are possible with electrometer tubes now available.

FOR many applications a direct current voltmeter with very high input impedance would be desirable. The average 'high' impedance voltmeter boasts of 10, 20, or possibly 100 megohms input resistance. These same meters are incapable of being used to indicate potentials on the order of ten millivolts. It has been possible for some time to construct d.c. voltmeters with almost inconceivably high input resistances. With comparatively little trouble voltmeters with an input value of 1,000,000 megohms (1,000,000,000,000 ohms) can be constructed. Resistance values of this magnitude are generally referred to as log functions, the above being 1.0×10^{12}. This advance has been assisted greatly by the advent of the electrometer tube pioneered and perfected by the *Victoreen Instrument Company* of Cleveland, Ohio. Electrometer tubes are so designed and constructed that minute grid current is drawn. This is necessary, because it can easily be seen that a very small amount of grid current thru a grid resistor of the above magnitude would place a varying and objectionable grid bias on the tube. The electrometer tubes VX32/5803 and VX41/5800 have grid currents on the order of 10^{-14} ampere when properly operated. Converting 10^{-14} into decimal figure we arrive at .000,000,000,000,01 amperes. Due to the liberation of photoelectrons when in light these tubes must be enclosed so that no light falls upon them. Careful shielding is also required to prevent 60 cycle hum pickup which in any strength will cause the tube to become paralyzed. Without shielding it is possible to detect a 60 watt electric light bulb twenty feet away due to its alternating magnetic field, if this sort of application is desired. Due to the very high leakage resistance of the electrometer tube base and grid resistor they should not be touched with the fingers or contamination will occur. Should contamination occur by some accident it is possible to restore the original surface resistance by washing the tube base with alcohol and distilled water and baking in an oven for about an hour at 100°C.

Resistors can be obtained from 10^{8} to 10^{15} ohms to be used with the above tubes. The temperature and voltage coefficient of these resistors are very small, in the order of 0.1 per-cent combined per degree Centigrade. Normal operating range is from —40°C. to 120°C.; relative humidity up to 98, and a voltage range of 100 microvolts to 1,000 volts. Resistors cost $5.50 up to 100,000 megohms, while electrometer tubes list at $12.50 each. For the average use the VX32/5803 electrometer tube is recommended.

It must be realized that substances normally thought of as insulators are in reality resistances which if allowed in contact with the grid of the electrometer tube will shunt the effective grid resistance to a lower value. It is strongly recommended that the grid probe support be a hermetic glass bead feed thru insulator; such as manufactured by *Electrical Industries, Inc.*, 42 Sum-

(*Continued on page 30*)

Fig. 1. Typical electrovolter using the 5803 electrometer triode. Note that the leakage resistance of the tube is used as the grid resistor.

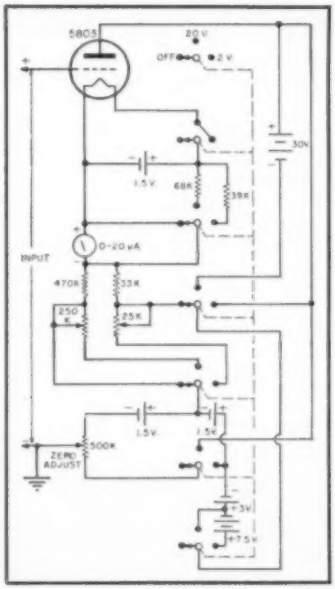
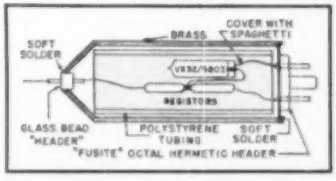


Fig. 2. Probe for use with Fig. 3.



V.H.F. TANK DESIGN

This flat type quarter-wave tank combines the desirable characteristics of coaxial and balanced two wire circuits.

By
B. E. PARKER

AT V.H.F. the design of the grid and plate tank circuits becomes of increasing primary importance. Many factors often completely disregarded at lower frequencies must be carefully evaluated in the design. Some of these practical considerations are shown for the three most commonly used forms of quarter-wave sections of transmission line. Each of these three types, coaxial, balanced two wire, and flat element, may be represented by the equivalent low frequency lumped form shown in Fig. 3. In transmission lines the inductance and capacity are in actuality distributed throughout the entire length.

The effective values of L and C are determined by the surge impedance of the line. It is apparent from this that the design of the tank circuit is largely dependent on this characteristic surge impedance.

Each of the three types of transmission lines when used for tank circuits has its distinctive advantages.

The coaxial type tank lends itself readily to single-ended construction where only one tube is used. The radiation losses are extremely low since the conducting surfaces are effectively shielded by the outer conductor. Short tube connections are realizable as the tube can be placed often right into the end of the coaxial tank. Numerous coaxial tube types are available on the market and are designed specifically for this application. The characteristic surge impedance of the tank can be made quite low to permit tank lengths sufficiently long for good efficiency. The relationship of the surge impedance to the effective electrical and physical length of the tank will be shown later.

The balanced two wire line lends itself quite readily to push-pull operation. With push-pull operation the tube input and output interelectrode capacities are in effect connected in series which decreases considerably the shortening effect of the tube capacities on the physical length of the tank. In other words, the use of a tube type having 10 $\mu\mu$fd. input capacity in a push-pull circuit would result in only 5 $\mu\mu$fd. appearing across the end of the tank. Even order harmonics are largely eliminated by the push-pull operation. This is often advantageous where second harmonic radiation must be suppressed to a high degree.

The flat type quarter-wave tank is essentially an outgrowth of the balanced two wire line, in which the wires or round elements have been replaced with flat elements. Fig. 2 is a representative tank circuit of this type. It has most of the desirable characteristics of both the coaxial and balanced two wire line circuits, as it can be made to have low characteristic surge impedance and fairly low radiation loss. It is easy to fabricate in even the most modestly equipped workshop which makes it ideal for experimental work. The flat type tank is adaptable to either push-pull or single ended operation. Fig. 5 shows a commercial application of such construction for push-pull operation. Fig. 1 shows an experimental laboratory unit using single-ended construction with a type 2E26 tube operating at approximately 170 mc. The commercial evolution of flat tank circuits is quite new, in fact, the writer knows of only one prominent FM manufacturer and two television manufacturers who have utilized this type of construction in new models.

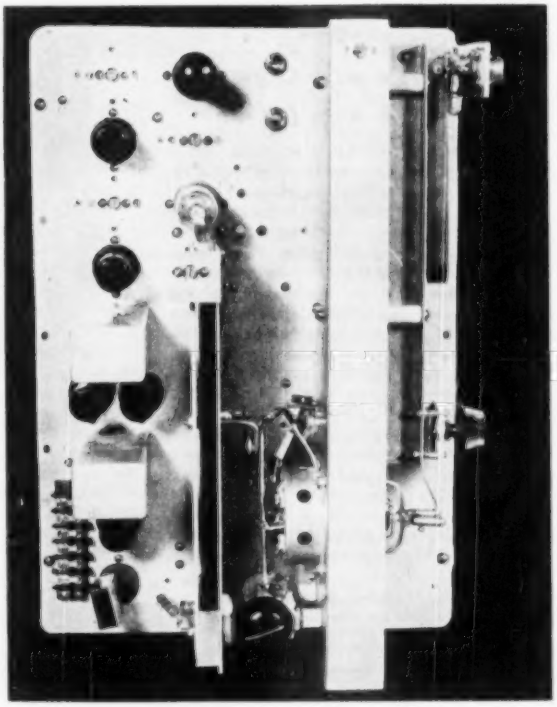


Fig. 1. Experimental laboratory unit using single-ended construction operating at approximately 170 megacycles.

Physical Lengths of Tanks

The physical lengths of all three types are dependent on characteristic surge impedance, tube interelectrode capacity, effective tube lead length, and shielding or proximity effects.

The characteristic surge impedance may be calculated for a coaxial tank by:

$$Z_0 = 138 \log_{10} b/a \qquad (1)$$

where Z_0 = characteristic surge impedance
b = radius of outer conductor
a = radius of inner conductor

For balanced two wire line:

$$Z_0 = 276 \log_{10} D/a \qquad (2)$$

where D = center to center spacing
a = radii of conductors

For flat element type:

$$Z_0 \simeq 377\, s/w \qquad (3)$$

where w = width of line
s = spacing between surfaces ($w > s$)

With the characteristic surge impedance and effective tube interelectrode capacity known, the physical length of the tank for any of the above types may be figured for a given frequency. Since for resonance the inductive reactance must equal the capacitive reactance ($X_L = X_C$) it will be necessary to find the reactance of the effective tube interelectrode capacity. The value of this capacity in $\mu\mu$fd. may be found in the tube handbook or manufacturer's literature. The line in order to be resonant must present an inductive reactance equal to this capacitive reactance. By the following, the length of the line may be calculated:

$$\tan \theta = jZ_o/Z_{in} \quad \ldots \quad (4)$$

where θ = length of line in degrees
Z_{in} = input impedance in ohms
Z_o = characteristic surge impedance

Taking a typical example for a flat element tank with the following parameters:

Tank spacing between elements	1"
Width of tank elements	2.5"
Effective shunt capacity due to tubes	16.5 $\mu\mu$fd.
Frequency	88 mc.

The capacitive reactance of this shunt capacity is 110 ohms.

To find the characteristic surge impedance, substitute in Eqt. (3). This gives Z_o = 151 ohms. Now to arrive at the electrical length in degrees and the actual physical length in inches, merely substitute in Eqt. (4). This gives a value of θ of 36.1°.

Since the wavelength is expressed in degrees (36.1°), this must be converted to inches. 36.1° corresponds to approximately one tenth (.1) of a wavelength. A wavelength at 88 mc. is 134 inches, making the tank length 13.4 inches.

Consideration must be given to two other factors which affect the final over-all length in practice, namely, tube electrode lead lengths and proximity effects of shielding. The

Fig. 2. Representative flat type of quarter-wave tank.

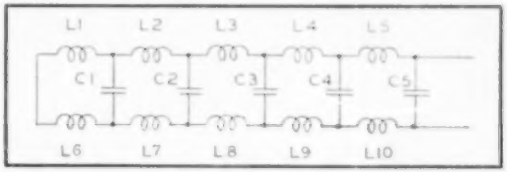


Fig. 3. Equivalent low frequency circuit of quarter-wave tank.

length of tube leads will serve to make the tank effectively longer electrically. The presence of shielding due to the enclosure and the chassis will serve to lower the actual characteristic surge impedance of the tank. This has the effect of shortening the electrical length of the tank. These effects may be considerably lessened by careful layout and mechanical design.

Tuning Methods

Tuning is usually accomplished by one or more of the following methods:

1. A variable capacitor placed across the high impedance end has been the most popular method. This works quite

(Continued on page 27)

Fig. 4. Power amplifier of a Gates 3 kw. FM transmitter, tuned by varying surge impedance of tank.

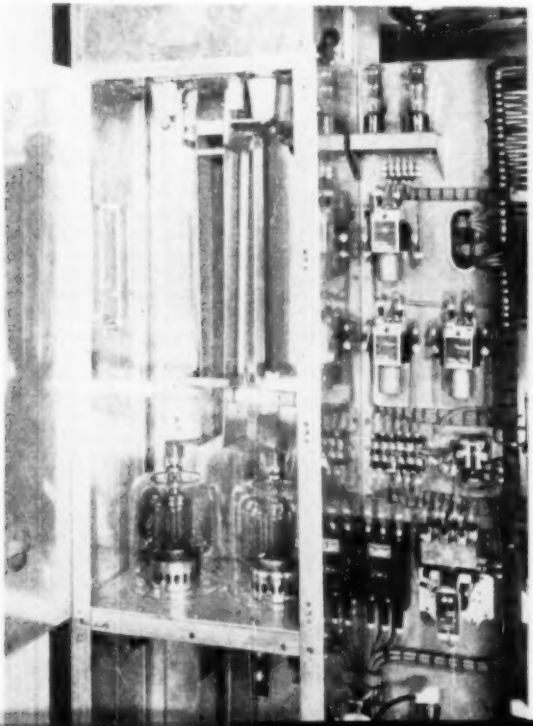
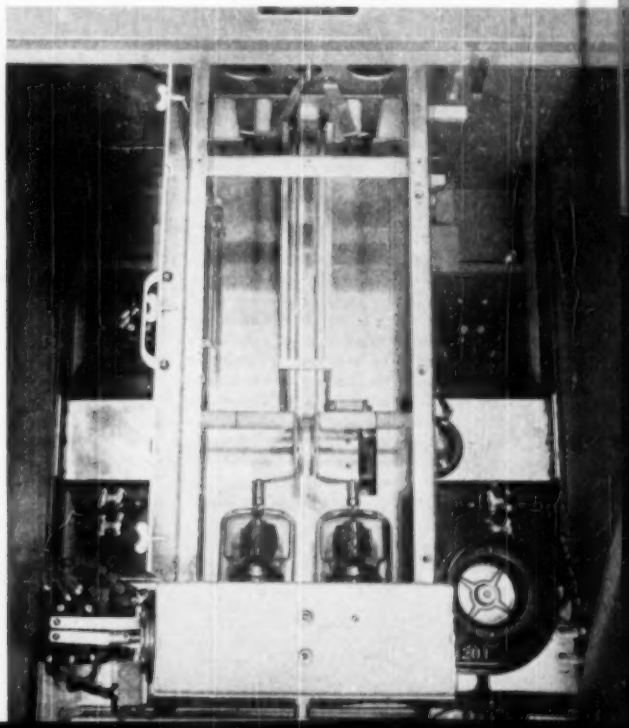
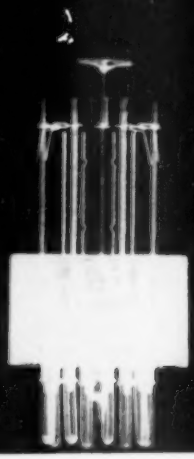


Fig. 5. Commercial application of the flat type of quarter-wave construction for push-pull operation.



RUGGED ELECTRON TUBE DEVELOPMENT



Mechanical vibration and resonance, high impact shock and centrifugal acceleration tests at NBS show up tube weaknesses and assist in evaluating more rugged designs.

RUGGED electron tubes are indispensable wherever electronic equipment is used under severe conditions of vibration, shock, or acceleration. Important in the development of such tubes are methods of testing for sturdiness and durability. These methods are now being studied and developed at the National Bureau of Standards as part of a comprehensive tube ruggedization program under the direction of I. L. Cherrick of the Bureau's Electron Tube Laboratory. One phase of the project consists of a survey of the actual operating conditions for electron tubes in various kinds of commercial, industrial, and military applications. This study provides a practical basis for the design of test equipment to simulate hazards of actual use.

In addition to working out adequate test methods, the Bureau is developing new kinds of rugged tubes. The design of these tubes is based on an analysis of the ways in which ordinary tubes fail under test or in service. A detailed knowledge of operating conditions and tube failures is thus a useful guide to the design of tubes that will be strong enough to operate properly under severe mechanical abuse. Some tubes may have to withstand great extremes of temperature as well, but in any case the mechanical design of a rugged tube is strictly governed by the required electrical properties.

The Bureau's facilities for testing the ruggedness of electron tubes now include vibration apparatus, mechanical resonance testers, high-impact shock machines, and high-speed centrifuges. Some tests are conducted with typical electrical potentials applied to the tube elements so that noise modulation, short circuits, and other effects can easily be studied. Destructive field conditions can be reproduced through the proper choice of vibration, resonance, impact, and acceleration tests.

After receiving various ruggedness tests, tubes are examined for structural failures. X-rays are sometimes used to reveal the extent of structural changes without opening the tube envelope. Materials for certain tube elements are examined spectroscopically to determine their exact composition and to find impurities that might weaken the tube structure. This determination of the real causes of tube failure is an important part of the rugged tube program. Out of these studies will come recommended specifications for materials best suited to particular ruggedization problems. In some cases new materials and new methods of fabrication must be developed to meet the unusual requirements of ruggedization.

Radiograph of two 6SN7GT tubes. Left, normal construction. Right, ruggedized version. Below, interior view of motor-driven centrifuge.

Vibrations produce the most common mechanical stress encountered by electron tubes under service conditions. Continuous and intermittent vibrations are present in vehicles, in aircraft, on shipboard, and in industrial applications. A survey of the actual vibrations in each type of service shows that there are definite, characteristic vibration frequencies—a noise spectrum—associated with each application. In motor vehicles the vibrations are usually of rather low frequency, but in aircraft they may range up to 10,000 c.p.s.

The Electron Tube Laboratory's mechanical vibration machines employ electric-motor drive arranged so that motor speed can be adjusted to vibrate the driven element at any selected frequency between 7 and 60 c.p.s. Vibration equipment of this type can, of course, be designed to produce higher

frequencies, but this is not usually done because of the lack of precision in frequency control, excessive wear on moving parts, and the appearance of unwanted harmonics. In some cases it may be useful to construct a vibration machine to work at a particular fixed frequency up to several thousand cycles per second, although it would be necessary to limit the amplitude of vibration to prevent self-destruction of the machine.

Several different types of low-frequency vibration apparatus are in use at the Bureau. One vibrator employs an unbalanced fly-wheel suspended on leaf springs; the frequency of vibration depends on the speed of rotation, and the amplitude depends on the stiffness of the springs. Also in use is a vibrator in which the circular motion of a flywheel is converted to linear vibration of a test table through a simple mechanical linkage. The amplitude of vibration is approximately 0.2 inch peak to peak.

Electron tubes are often tested by continuous vibration for periods of several days to produce fatigue failures at the points of weakness. These tests are usually conducted at a fixed frequency that is representative of field conditions. In shorter runs the vibration frequency is usually varied cyclically in order to study the effect of a range of frequencies on the performance of the tube under test.

Mechanical vibrations have many different effects on the operation and life of electron tubes. Fatigue failures due to vibration are very common in ordinary tubes. They are especially likely to occur in tube elements made of crystalline materials, such as filaments and cathode coatings. Improperly welded joints are another frequent source of trouble. When the tube is operated under vibratory conditions, flashovers between electrodes may occur, and mica contacts will often chip or split if they are placed against a glass envelope. The grid wires and the plate of an electron tube, however, seldom exhibit fatigue failures. High-amplitude resonance vibrations in the tube structure may occur at particular frequencies, and the vibration of tube elements may affect the operation of the tube by introducing microphonics. Noise modulation results from the vibration of tube elements and the consequent variation in interelectrode spacing.

Mechanical Resonance Tests

The most severe effects are encountered in cases where the vibration applied to the tube contains components of a particular frequency which corresponds to the natural frequency of vibration of some tube element or structure. The electrical noise in the output of the tube will then have a sharp peak at this resonant frequency which may be large enough to completely override the desired signal. Microphonic effects are a major problem in applications where the normal mechanical vibration occurs over such a broad frequency spectrum that the natural resonant frequency of a particular tube element is excited by some component of the incident vibrational energy.

Mechanical resonance apparatus differs from vibration equipment principally with regard to size—resonance testers are smaller and involve lower energies. The mechanical resonance testers in use at the Bureau are in the form of loudspeaker-type vibrators. The vibrator is excited by means of an audio oscillator and amplifier which produce an audio-frequency signal that can be varied from low frequencies up to more than 20,000 cycles per second. This vibration is monitored by means of a magnetic-type moving-coil vibration pickup attached to the tube mounting. The proper electrode potentials are furnished by a battery power supply to minimize extraneous noise effects. In testing for microphonism a special mounting is used to transmit the vibrational energy directly to the tube, and a cathode-ray oscilloscope is connected to the plate circuit of the tube so that noise modulation corresponding to a given mechanical vibration frequency will appear as a deflection on the oscilloscope screen.

At certain critical frequencies noticeable resonances may occur in any tube. The vibration of the plate itself may be sufficient to produce an objectionable noise effect. In some cases the mechanical resonance vibration may be sufficient to cause fatigue failure of tube elements. For example, oxide coatings of cathodes will often flake off as a result of resonance vibrations. The best preventive for resonance conditions is to design the tube so that the natural resonant frequencies of the various tube elements are higher than the vibration frequencies met in practice. It is important to use stiff materials for structural parts, to shorten the tube structure, and to design the cross sections of elements for greatest rigidity.

In general, mechanical resonance can be reduced by isolating the tubes from sources of low and high frequency vibration by means of rubber mountings of suitable design and by making

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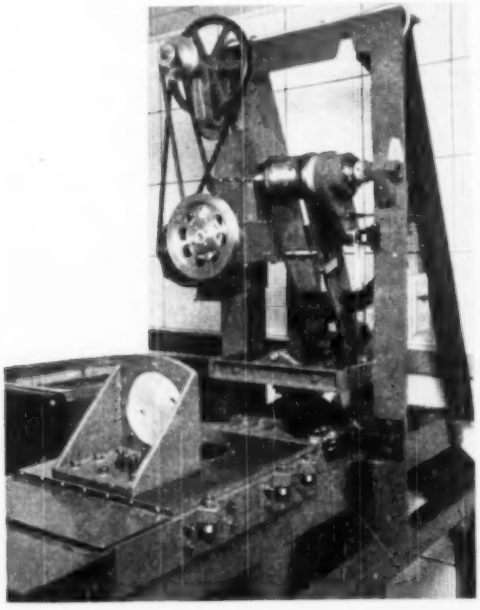
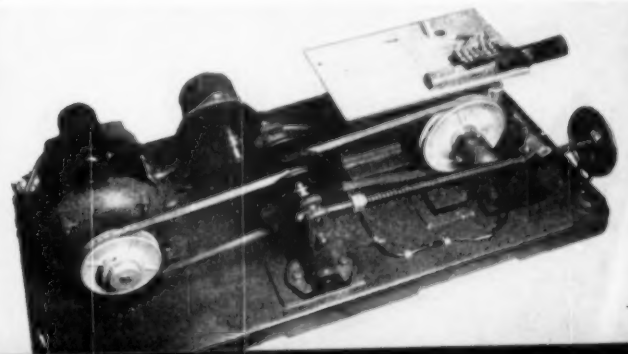


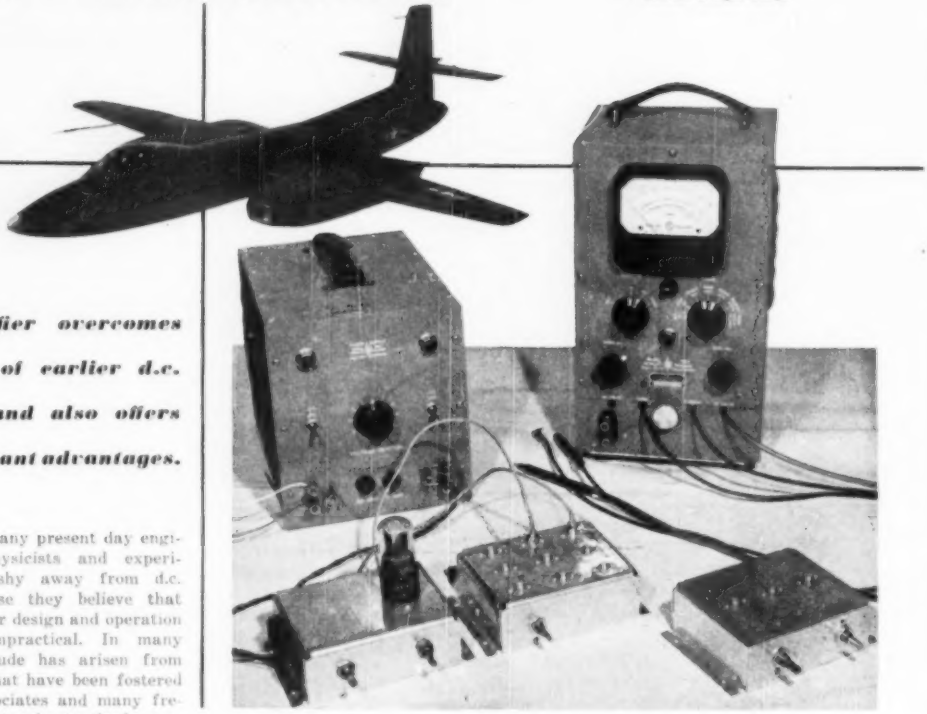
High-impact machine used at NBS to administer severe mechanical shocks to electron tubes. These tests determine the ability of tubes to withstand rough handling and dropping.



Mechanical vibration machines are used to test the ability of tubes to withstand low-frequency vibrations. This machine employs a cardioid cam to vary vibration frequency through a continuous cycle.

BRIDGE-BALANCED D.C. AMPLIFIER

By
G. A. and T. M. KORN
Curtiss-Wright Corp.



This amplifier overcomes drawbacks of earlier d.c. amplifiers and also offers some important advantages.

ALL TOO many present day engineers, physicists and experimenters shy away from d.c. amplifiers because they believe that difficulties in their design and operation render them impractical. In many cases, this attitude has arisen from misconceptions that have been fostered by teachers, associates and many frequently used electronics textbooks.

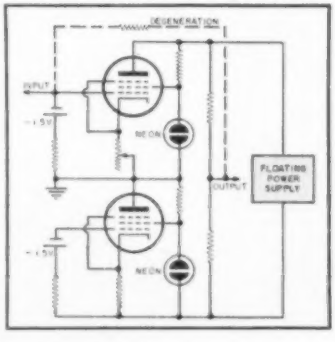
Modern circuits and techniques have overcome many of these difficulties. The new type of bridge-balanced d.c. amplifier described in this article not only overcomes earlier drawbacks of d.c. amplifiers but also offers several important advantages in ease of operation and low-cost construction. Furthermore, this new amplifier is particularly well suited to portable battery operation, making it valuable not only to engineers, physicists and experimenters but also for certain applications in physiology and photography.

A d.c. amplifier might be defined as one which has a finite gain at zero frequency, but perhaps a more meaningful definition may be obtained by comparing a d.c. amplifier with an ordinary a.c. amplifier. In the a.c. amplifier, the output voltage is not affected by d.c. voltage changes at the input since the output and input are isolated by capacitors. A change in the input level of a d.c. amplifier, however, results in an amplified change of the output d.c. level.

Fig. 1. D.c. amplifiers, a simple power supply, and some capacitive networks form a small electronic computer. Raggazini[1] has shown that such devices can simulate flight conditions of a new type airplane long before the first model is built. The aircraft shown is a Curtiss XF-87.

This property of d.c. amplifiers permits them to amplify voltages which vary quite slowly, such as those

Fig. 2. Loss in gain due to unbypassed cathode resistors may be avoided through the use of bias cells.



obtained from pressure gauges, thermocouples and certain other measuring devices. High quality d.c. amplifiers have long been applied in physiological research work to measure nerve currents. More recently, they have acquired a new and striking usefulness in their application to servomechanisms and analog computers. They serve as electronic voltmeters and also provide low-frequency amplifiers for photocells, oscilloscope deflection plates, etc.

The ideal d.c. amplifier for all these applications would be one having high stable gain, good frequency response and freedom from drift. Drift in d.c. amplifiers may be caused by changes in plate and filament voltages as well as changes in contact potential, tube characteristics, and circuit component values. It would also be highly desirable to obtain the output at the same d.c. level as the input using a minimum

number of power supplies. This latter characteristic would permit convenient cascading of similar stages and application of feedback circuits. The ideal d.c. amplifier should also provide ease of operation, ruggedness, and easy balancing while requiring only readily available, low-cost circuit components.

Several means for achieving these desirable characteristics are already available. In addition to the familiar parallel or Miller compensator,[2] series compensation,[3] as shown in Fig. 4, has been used to eliminate the effects of changes in filament emission and contact potential in d.c. amplifiers. Emission and contact potential changes similar to those in the amplifier tube V_1 occur in the compensator tube V_2 and tend to balance out the resulting drift at the output terminal B. If the output is taken between B and C, changes in the plate supply voltage also tend to be balanced out and little or no regulation is necessary in the plate supply. In this series compensating circuit, the signal is applied to the grid of tube V_1 with the output being taken from the plate. For zero signal input, the quiescent output voltage varies from slightly above to slightly below 100 volts. This tends to make cascading and application of feedback from the output to the input difficult since the following grid would have to operate at a high positive potential. If, however, output is desired at zero d.c. level, a negative power supply is needed as indicated in dotted lines, and both supplies must be regulated.[3]

The new type of bridge-balanced d.c. amplifier to be described has all the advantages of series compensation and at the same time directly provides output at zero d.c. level and permits both the output and input voltages to be conveniently referred to a common ground reference.

In the simplest form of the new amplifier, shown in Fig. 6A, the amplifier tube V_1 and the compensator tube V_2 constitute two arms of a bridge in such a way that both input and output voltages appear at zero d.c. level. The power supply may or may not be left floating with respect to d.c. ground, thereby presenting several possibilities. It should be noted that only a single power supply is needed, although one positive and one negative supply may be used in series if desired.

The output voltage is balanced to the zero d.c. reference level at zero input by means of the variable cathode resistors indicated in Figs. 2, 3, 4, 6A, and 7.

The power supply may be center-tapped, as shown by the dotted lines in Fig. 6A. This scheme is used if several stages are to be cascaded, as in Fig. 3, and must be operated from the same power supply. An inspection of the circuit in Fig. 6A shows that the stage gain of the new amplifier is exactly one-half of the gain of the conventional stage shown in Fig. 6B. Comparison of the corresponding circuit elements in Figs. 6A and 6B enables one to design the new amplifiers by means of *standard resistance-coupled amplifier tables*, if allowance is made for the degeneration due to the unbypassed cathode resistors. The loss in gain may be avoided through the use of bias cells as shown in Fig. 2.

If only a single stage of amplification is involved, the power supply may also be floating with respect to ground (except for high audio frequencies at which the distributed capacitances C effectively bypass both sides of the supply

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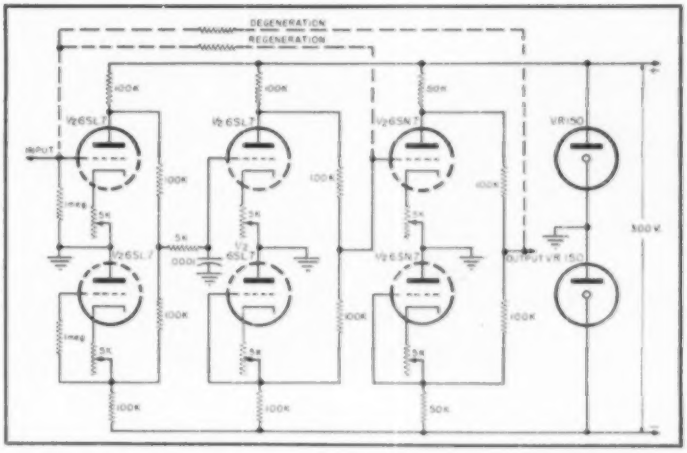


Fig. 3. Center-tapped power supply used when several stages are cascaded.

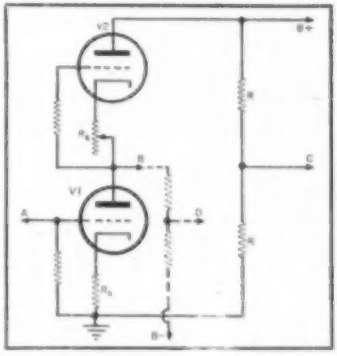


Fig. 4. Series compensation has been used to eliminate the effects of changes in filament emission and contact potential in d.c. amplifiers.

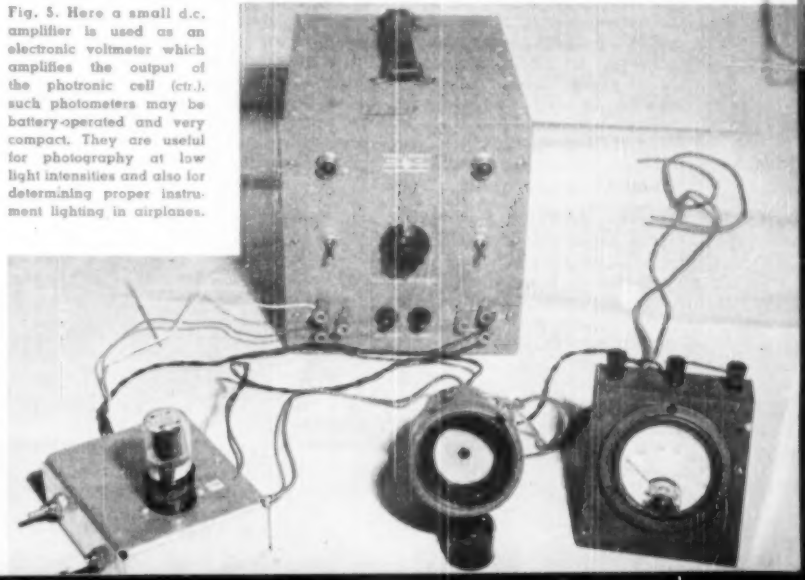


Fig. 5. Here a small d.c. amplifier is used as an electronic voltmeter which amplifies the output of the photronic cell (ctr.). such photometers may be battery-operated and very compact. They are useful for photography at low light intensities and also for determining proper instrument lighting in airplanes.

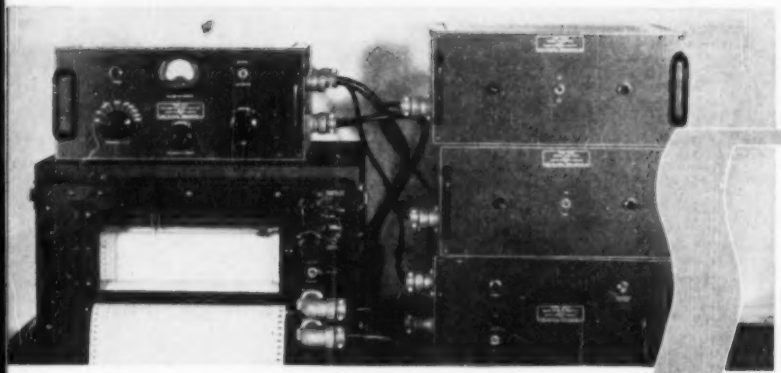


Fig. 1. The complete automatic recorder ready for operation.

By
HARRY L. GERWIN

High sensitivity and rapid response make this recorder suitable for checking a wide variety of antennas.

AUTOMATIC ANTENNA Pattern Recorder

THE LARGE number of field strength pattern measurements required to adjust properly and/or evaluate an antenna inevitably lead to the use of automatic recording equipment. An automatic recorder has been devised which is capable of recording accurately and quickly a complete field strength pattern. The principal objective in the design of this device was high-speed response of the writing pen drive system without loss of accuracy. This feature is necessary, since the system is required to record patterns of rotatable antenna systems in which the mount is sometimes limited in how slowly it can rotate and still rotate smoothly. This minimum rotational rate determines the pen-writing response required because the faster the antenna is rotated the faster the pen must travel to trace out the pattern.

Characteristics of Recorder

It is generally desirable to measure the relative radiation power of an antenna pattern in decibels. The recorder must then produce a linear writing pen displacement proportional to the logarithm of the r.f. power derived at the antenna. The linear decibel output is particularly advantageous because it produces a recording of the power variations encountered in measuring a field strength pattern of an antenna that has the same degree of accuracy at any point on the scale. The measuring range of this recorder is 40 db. plotted on a 10-inch scale.

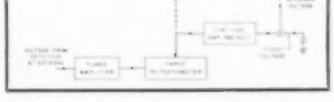
An indication of the response characteristics of the pen servo is shown in Fig. 4, which is the output curve plotted by the pen servo system for a 19.6 db. amplitude square wave input. It is seen that the pen servo will correct for an approximate 20 db. step function in 0.185 seconds. Over-all accuracy of the system is dependent primarily on an input potentiometer made up of inherently stable resistive elements.

Since the chart displacement must be linear it is made proportional to the angle of rotation of the antenna. As the recorder was designed for measuring narrow beam antennas, the patterns are plotted in cartesian coordinates. The paper can be driven at any one of three speeds: 20¼" per 10°, 20¼" per 60°, or 20¼" per 360°.

Pen Drive System

A block diagram of the pen drive servo system is shown in Fig. 2. To facilitate the measurement of r.f. power, the power source is amplitude-modulated at a convenient frequency, generally between 500 and 2000 c.p.s. The voltage derived from the detector (usually a bolometer) affixed to the antenna under test is fed to a tuned amplifier which has a bandpass of approximately 10 per-cent of the modulating frequency. The tuned amplifier is used to reject unwanted signal frequencies, thereby obtaining higher sensitivity. This characteristic is necessary because the recorder must be extremely sensitive to measure the side lobes and minima of an antenna pattern when the power output of the r.f. source is limited and the gain of the antenna under test is low.

Fig. 2. Block diagram of pen drive system.



The output of the tuned amplifier, which is linear over an amplitude range of 100 db., feeds an input potentiometer in which the output voltage of the sliding contact varies in a negative exponential fashion with a linear movement of the contact. This output voltage provides the control signal for the servo motor which repositions the sliding contact and the writing pen attached to it. Servo systems are designed on a linear basis; therefore it is necessary to modify the voltage from the sliding contact so that it varies linearly with a linear movement of the contact. This function is performed by the lin-log amplifier, whose output varies as the logarithm of the input function.

Up to this point in the system the original modulating voltage has been used. The output of the lin-log amplifier is rectified to produce a d.c. voltage which is compared with an arbitrary fixed voltage, and the difference or error voltage is fed to a modulator. The modulator converts the d.c. error voltage to

a 60-cycle a.c. error voltage which drives one phase of a 2-phase motor. The motor then positions the sliding contact on the potentiometer, thus reducing the error voltage to a minimum. The sliding contact and writing pen seek a position which is proportional to the logarithm of the voltage fed to the input potentiometer. In this way the linear decibel type of pen writing is obtained.

The fast response time with a critically damped system was made possible by the unique pen drive system. The pen carriage (which also holds the movable tap of the input potentiometer) is driven by a cable from a drum fastened to the motor shaft. This type of drive system (shown in Fig. 5) provides low inertia, no backlash, low friction, and a mechanical resonant frequency above the passband characteristics required. Local feedback is applied in the usual manner to extend the frequency characteristics of the two-phase induction motor, to reduce its nonlinearity and to improve the servo output stiffness, thus improving static accuracy.

The input or negative-exponential potentiometer mentioned above is approximated by cascading a number of symmetrical π sections made up of resistive elements. It is constructed by starting with a slide-wire potentiometer to which shunt resistors have been added at equally spaced intervals to form the π sections (see Fig. 3). The potentiometer is an approximation to the desired function since the function is correct only at the tap points; at all other points the voltage at the sliding contact is a linear interpolation of the voltage between taps. By the use of a suitable number of elements the maximum error can be reduced below the operating accuracy expected of the entire system.

The antenna pattern recorder has a voltage range of 80 db. Using a bolometer as a detecting element (square-law detection) a total range of 40 db. variation of r.f. energy can be recorded on the chart.

Chart Drive

The chart drive performs the function of maintaining a chart displacement that is directly proportional to the angle of rotation of the antenna. A block diagram of the basic system is shown in Fig. 5. It consists of a synchro generator, a synchro control transformer, a servo motor amplifier and a two-phase induction motor.

The synchro generator, driven mechanically from the antenna mount, initiates 60-cycle voltages which are transmitted to the synchro control transformer at the recorder. A difference in the relative angular position of the synchro generator at the antenna mount and the synchro control transformer at the recorder generates an electrical error signal which is applied to the input of a servo motor amplifier. The amplifier output operates the two-phase chart motor which drives, through appropriate gearing, the synchro control transformer in such a direction that the error signal is reduced to a minimum. The angular position of the control transformer is thereby kept aligned with the synchro generator at the antenna mount. The recording chart drum is geared directly to the control transformer, and thus, the paper displacement will always indicate the antenna position. Actually, two synchro control transformers are appropriately geared to the chart paper drum and the chart drive motor. When the antenna system is provided with two synchro output speeds geared 36 to 1, and 1 to 1, the three chart speeds are available by switching electrical connections without the necessity for shifting gears at any time.

Local feedback is also applied in the chart drive system to obtain improved operation. This insures precision tracking between the chart paper and the antenna mount.

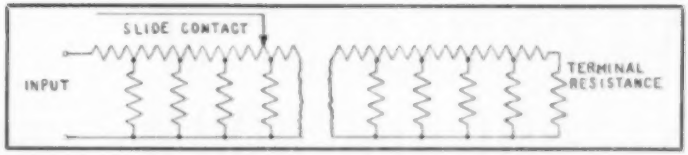


Fig. 3. Schematic diagram of negative-exponential potentiometer.

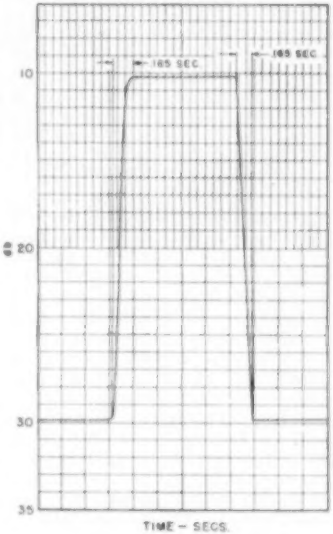


Fig. 4. Output curve plotted by pen servo system for a 19.5 db. square-wave input.

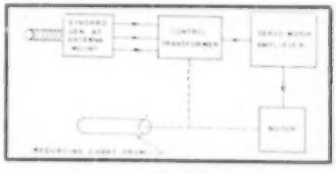


Fig. 5. Block diagram of the basic chart drive system.

Systems Operation

Fig. 1 is a photograph of the complete recorder system, which is built as five individual units in order to make it portable. Most antenna work is done at fixed installations and the equipment lends itself to rack mounting, but in many cases it is desirable to measure antenna patterns of radar or radio equipment on location. Such patterns are easily obtainable. The radar transmitter can usually be used as the power source and the only additional equipment needed is a bolometer holder matched to the frequency being measured, an r.f. pickup element such as a dipole, horn, or parabola, synchro inter-connecting wiring and a suitable location for the pickup element. The precautions taken in setting up a permanent installation must also be

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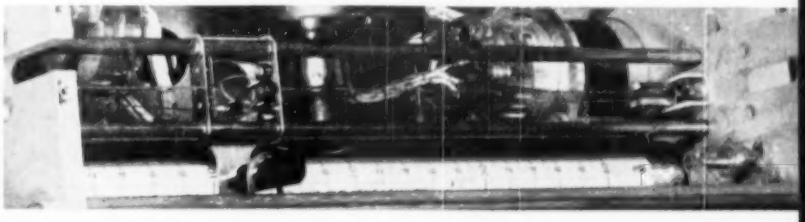
Fig. 6. A view of the pen drive system.



MEASUREMENT of STUDIO and ROOM ACOUSTICS

by

DAVID FIDELMAN

The General Radio type 759-B Sound Level meter.

Part I of a 2-part article discussing such factors as reverberation, sound diffusion, and noise level.

THE FIELD of sound reproduction has at the present time reached the stage of development where it is possible to reproduce sounds from a loudspeaker, after numerous stages of recording and transmission, which will sound almost indistinguishable from the original sounds which entered the microphone. In addition, present electronic and electromechanical techniques are constantly being used to improve sound reproduction equipment toward the ultimate purpose of making the reproduced sound identical with the original.

However, no matter how well the output sound reproduces the input, the entire character of the reproduction can be drastically altered by faulty acoustic design either in the room where the sound originates, or in the room where it is reproduced. Bad acoustic design can result in loss of intelligibility and "presence," increased noise level and reduction of dynamic range, resonances and spatial distribution defects, and generally make good program material unpleasant to the ear. This factor has long been recognized, and considerable work has been done in the design of studios, rooms and auditoriums to determine how to attain the best acoustic qualities. The problem is a complex and difficult one, and has still not been solved to complete satisfaction, although considerable progress has been made toward its solution.

Even under ideal conditions, the design of any room, studio or auditorium is difficult because of the limitations imposed by architectural factors. Therefore compromises usually must be made in designing for optimum acoustic performance. Then, once the room has been completed it is tested to see how well it meets the performance requirements. Methods of testing form an extremely important part of any type of design procedure, and in acoustics this is especially true. The ideal test gives a measure of the performance, indicates what may be wrong and by how much, and gives some indications of what steps may be taken to correct any defects which may exist.

Such tests have only recently been developed for acoustic measurement, and have considerably increased our knowledge about what factors are important in determining the acoustic quality of a room, and what their effects are. The purpose of this article is to describe these measurement techniques, and to show how they aid in the improvement of acoustic designs.

In order to understand the methods and equipment used for the measurement of studio and room acoustic properties, it is first necessary to understand what factors are involved and their effects upon any sounds which are present in the room.

Specific Factors Which Determine Acoustic Properties of Rooms

When sound is listened to in a room or an auditorium, the room has two important effects: (a) it reverberates and reflects the sound from the walls, ceiling and floor; otherwise, if there were no reverberation, the sound would appear as if it were being heard in a completely open space; (b) it excludes external noises. Therefore measurements of the acoustic properties of rooms must concern themselves primarily with various types of reverberation and noise measurements.

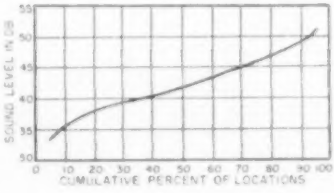
Reflections from the boundary surfaces of the room, which basically determine its acoustic character, can have several different effects depending upon the nature of the sound which is heard. These different effects require different measurement techniques.

In general, a number of measurements must be performed before it can be determined whether the acoustic properties of a room will be acceptable. Usually the factors which should be known include the following:

(1) Reverberation and reverberation time, including
  (a) fluctuation during decay
  (b) echo and flutter echo
(2) Sound diffusion (and sound concentrations)
(3) Transient characteristics
(4) Noise level

and when the room is the one in which the sound is being reproduced, it is also desirable to know the relationship between the reproducing system and

Fig. 1. Graph showing the residual room noise level in homes.

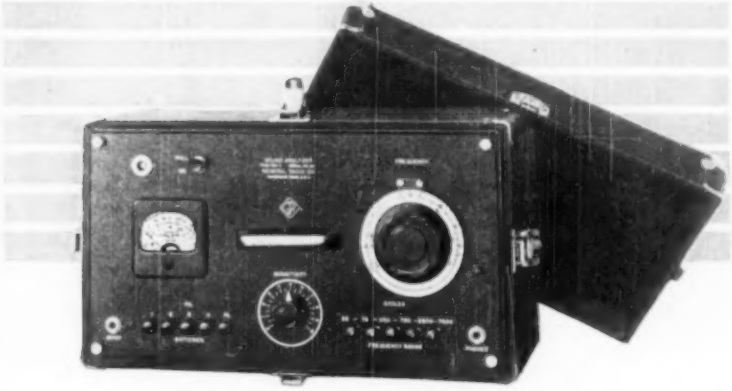


the room acoustics, as given by:

(5) Power output of the reproducing system

(6) Frequency response of reproduced sound

Some of these factors have been studied extensively, and standards determined which correlate the measured value with the acoustic performance. In the case of a few of the above factors, standards have not yet been determined, but practical experience has shown what should be the requirements for acceptability.



The General Radio Type 760-A Sound Analyzer.

When a sound is started in a room the intensity does not immediately r[illegible] its maximum, because it takes an appreciable time for some of the sound to reach the walls and undergo one or more reflections before it reaches the listening point. The intensity reaches its maximum when the steady-state condition is attained. After the sound source stops, it also takes an appreciable time before the various reflections are no longer heard, having been completely absorbed. This persistence of sound is called *reverberation*, and is different from an echo in that it consists of a large number of reflections which blend evenly with one another and with the original sound. The *reverberation time* has been defined as the time required for the sound intensity to decrease 60 db. after the source has been stopped.

When there are large flat surfaces, these may give rise to distinct reflections which are heard as *echoes* if the path difference is too great. When parallel walls are located opposite one another, there may be heard a succession of distinct reflections between them—this effect is known as *flutter echo*.

The presence of concave surfaces tends to focus sounds towards their center of curvature, giving a greater sound intensity than at other points in the room, and creating the impression that the sound originates at the concave surface. If standing-wave patterns are possible at certain frequencies, these frequencies will tend to be overaccentuated at positions where the standing-wave patterns are set up. For best acoustic properties, the sound pattern in the room should be as *diffuse* as possible at all frequencies, with no standing-wave patterns and no points of excessive sound concentration. Under these conditions, the decay of sound (reverberation) when the source stops will be smooth, marked only by small fluctuations.

The reverberation time and the sound diffusion characteristics of a room are essentially steady-state characteristics, since the sound is allowed to reach equilibrium conditions before these factors are measured. However, all natural sounds are essentially transient in nature, therefore the behavior of the room for transient sounds is of great importance. It is therefore necessary also to know whether the steady-state reverberation time and sound diffusion are accurate for transient sounds, and what differences may exist. In many cases the transient characteristics are much more important than the steady-state, and sometimes give much more information about the characteristics of the room.

The ease with which the reproduced sound may be heard and understood, and the dynamic range which is possible, depend upon the residual noise level in the room. The tolerable noise level in the studio and in the reproducing system depends upon the noise level in the listening room. The average noise level in empty theaters is 25 db. (reference level is 10^{-16} watts per square centimeter); with an audience the average will generally be about 42 db. The noise

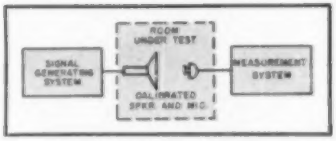


Fig. 2. Basic test setup for performing acoustic measurements in rooms.

level of most residences is given in Fig. 1, which shows that there is a wide variation in noise from one location to another.

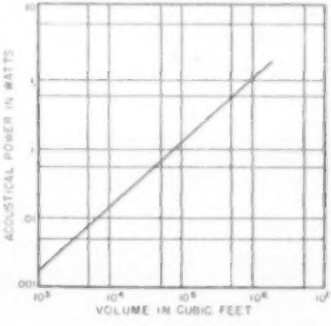
In any audio reproduction, it is important also to know the relationship between the reproducing system and the acoustics of the listening room. The power output from the loudspeaker should be capable of producing a minimum sound intensity of 80 db., and for best performance should be capable of producing a level up to 100 db. without distortion. Fig. 3 shows the acoustical power required, as a function of the room volume, to produce a sound level of 80 db.

The sound output from the loudspeaker should have a flat frequency response characteristic. The function of the reproducing system is to reproduce at the ear of the listener a duplication of the sound which is present at the microphone, and to affect the tonal qualities as little as possible. In certain cases it is necessary to restrict the reproduced frequency range because of acoustic or reproduction difficulties, but in such cases the restriction is a compromise rather than a desirable situation.

General Technique of Acoustic Measurements

Acoustic measurements consist essentially of generating a known sound signal in the room which is under test, and determining the resulting sound distribution. The basic setup for performing measurements of this type is shown in Fig. 2. A signal generator of the proper type supplies the desired

Fig. 3. Acoustic power required to produce an intensity level of 80 db. as a function of the room volume.



The General Radio type 759-B sound level meter being used to perform acoustic measurements in a motion picture theater.

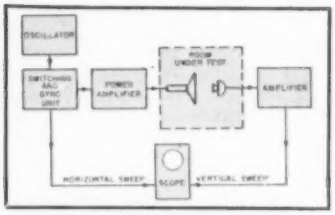


Fig. 4. Setup for performing transient acoustic measurements.

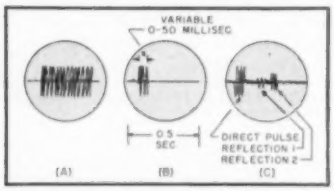


Fig. 5. Typical oscillograph pictures of wave shapes in various parts of a test setup. (A) audio oscillator output. (B) sound output of loudspeakers. (C) sound received at microphone.

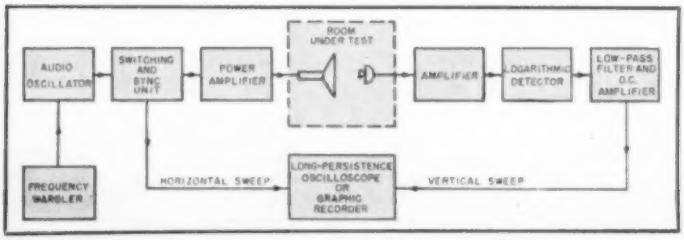
signal which is applied to the calibrated loudspeaker. (The signal generator here is taken to include not only the generator of the low-level signal, but also any auxiliary amplifiers which may be necessary to increase the electrical signal level before applying it to the loudspeaker so that the necessary amount of sound energy may be supplied for testing.) When testing a room in which sound is to be reproduced, it is often preferable to use the amplifier and loudspeaker system which is already installed; then the electrical test signal is applied directly to the amplifier input. The sound in the room is picked up by a microphone of known characteristics, whose output is amplified and applied to the measuring device. The specific type of signal which is generated, and the type of measurement system, will be determined by the particular acoustic characteristic under test.

Generally, a calibrated loudspeaker will not be available, whereas standard calibrated microphones are readily available. It is not necessary that both the loudspeaker and the microphone have known characteristics, since if the characteristics of one are known it can be used to calibrate the other. Therefore only a standard microphone is necessary to obtain completely accurate and reliable acoustic measurements. A calibrated microphone which has been widely used for this type of service is the condenser microphone. These microphones are calibrated against a primary standard sound source, and may therefore be used as secondary measurement standards. Because of its small physical dimensions this type of microphone is effectively a "point pickup" which does not appreciably disturb the sound field, and it has good frequency response characteristics up to approximately fifteen thousand cycles per second.

The characteristics of the loudspeaker may be calibrated in terms of the microphone characteristics. However, such a calibration must be done in such a manner that the acoustics of the measuring room do not affect the results. The measurement must be performed in what is known as a "field-free" room. The requirement of such a room is that all reflected sound and the noise level be so low that they can be neglected in the measurement. The simplest and most direct method of obtaining these conditions would be to perform the calibration out of doors at a great distance from reflecting objects, if favorable weather and noise conditions can be obtained. Field-free conditions are also achieved in special rooms which are carefully designed to have extremely small reflections from the boundary surfaces. In practice the best measuring room available will be a small deadened or partially deadened room. In such cases, the most satisfactory results are obtained by placing the microphone close to the loudspeaker so that the level of the direct sound striking the microphone is at least 20 db. or more above the reflected sound.

In most acoustic room measurements the effects of standing waves are undesirable and should therefore be minimized. This can most readily be done by frequency-modulating the test signal (usually called "warbling") by about ± 10% of the mean frequency, at a rate of several times per second. When this method is used there will be continuous small changes in the standing-wave pattern, but resonances will not have a chance to build up.

Fig. 6. Measurement setup for determining reverberation time.

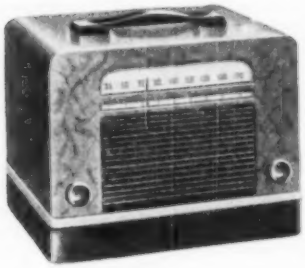


Measurement of Specific Acoustic Characteristics

The basic setup of Fig. 2 is used for measurement of all the various factors that represent the acoustic properties of studios and rooms. Different types of signal generators and measuring devices are used, according to the specific factor being measured.

The method of measuring reverberation time is indicated schematically in Fig. 6. The signal is generated by an audio oscillator set to the desired frequency and warbled. The output of the oscillator is applied to the switching and synchronizing unit, which controls the sequence of measurement operations. The signal is then amplified by a power amplifier which drives the loudspeaker that generates the sound signal. The sound in the room is picked up by the microphone and amplified, then detected by a logarithmic detector to give a d.c. reading on a (decibel) scale, and fed to a low-pass filter. The output of the filter is then amplified by a d.c. amplifier. The amplified output, which gives the reverberation decay characteristics of the room, may be observed either by means of a graphic pen-and-ink level recorder or upon the screen of a long-persistence oscilloscope.

The switching and synchronizing unit turns on the sound source for a time long enough for steady-state conditions to be reached, then switches off the signal and permits the sound in the room to decay. The microphone picks up the sound intensity in the room at all



TRIPLE "A" BATTERY LIFE OF YOUR 1950 PORTABLES

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Typical Operating Conditions

Characteristic	1AF4	1AF5	1U6	3E5
Filament Voltage (volts)	1.4	1.4	1.4	2.8
Filament Current (ma)	25	25	25	25
Plate Voltage (volts)	90	90	90	90
Transconductance (μmhos)	950	600	275*	1100
Plate Resistance (megohms)	1.8	2.0	0.6	0.12
Power Output (mw)	—	—	—	175

*Conversion Transconductance

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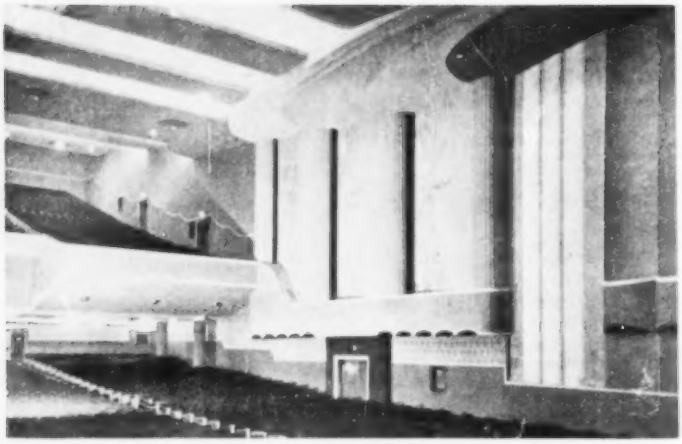


Photograph of the interior of the Cine Orfeon, Mexico City. Note sound-diffusive construction of walls and ceilings; undesirable resonances and reflections are further minimized by use of sound-absorbing material on back and side walls above wainscoting, and on front of balcony.

The H. H. Scott Type 410 A Sound Level Meter.

times, and the sound intensity at the microphone is plotted upon the oscilloscope screen or by the graphic recorder. The decay of sound from the moment the source is switched off is observed, and the slope of the decay curve is measured to give the reverberation time for 60 db. decay. There may be fluctuations during decay of the order of 10 or 20 db., but the average slope is the one which is used. In estimating the decay time it is preferable to use the initial slope, since this is the most important to the ear and the remaining portion of the decay is normally masked by subsequent sounds. The presence of large-scale fluctuations and changes in the average slope of the decay curve indicates that the room does not have a completely diffuse sound pattern, and that best acoustic performance has not been achieved.

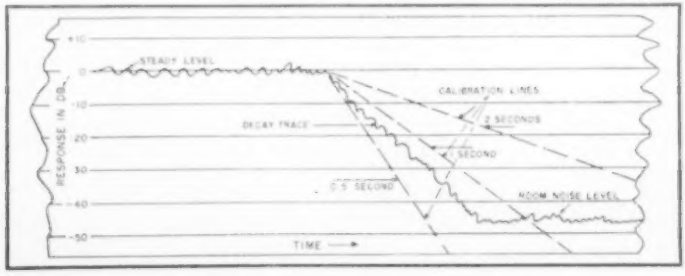
When the sound decay curve is being measured by a graphic recorder, the measurement setup shown in Fig. 5 may be used without the synchronizing and switching unit. In this case, the sound source is turned on and kept on long enough for steady-state conditions to be reached, then the paper is allowed to run in the recorder and the sound source switched off. The sound decay pattern will then be recorded.

Because of the cyclically changing standing-wave pattern due to the frequency-modulated signal, when the graphic recorder type of measurement is used the recorded decay curve will be different depending upon the exact time at which the signal is cut off. With the oscilloscope method of measurement these fluctuations tend to average out, due to the superposition of a number of different decay curves which in general start at different times in the warble cycle. The effects of standing-wave patterns and interference effects can be further smoothed out by the use of multiple loudspeakers and microphones. In practice, it is desirable to reduce these errors by taking several measurements for each of several locations of loudspeaker and microphone, differing in position by about one yard. If three readings for each of four different positions are taken, accuracy in reverberation time to about 0.1 sec. can be obtained.

The degree of sound diffusion is measured mainly by observing the standing-wave pattern in the room when sound is present. Some indications can be obtained from the reverberation characteristic, but such observations are not too good because in measuring reverberation steps are taken to eliminate the effects of standing waves. The simplest and most direct method of determining the standing-wave characteristics of a room is to produce a steady sound in the room and survey the room with the microphone to determine the intensity pattern. (In this type of measurement an omnidirectional microphone should be used, and the directional pattern of the loudspeaker radiation taken into account.) With complete diffusion the sound intensity will be uniform throughout the room for all frequencies, or will vary gradually with position according to the directional characteristic of the loudspeaker and the absorption by air of the higher frequencies. The relative intensity of maximum and minimum points will be a measure of the diffusive character of the room, and any sound concentrations will also be detected. Another method of performing this measurement is to keep the microphone fixed and slowly sweep the signal frequency over the entire audio range. Assuming the frequency characteristics of the loudspeaker and the microphone to be reasonably flat, variations in response will indicate standing waves in the room. However, this latter method does not indicate whether there may be any concentrations of sound at various points in the room.

The transient characteristics are measured by applying a test signal which has transient properties similar to those of natural sounds, and observing the resulting sound at the loudspeaker. This method has the advantage that the results can be expected to

Fig. 7. Typical decay curve obtained in measuring reverberation with a graphic recorder.



correspond closely to the actual conditions under which the room will most often be used. The complete test setup for this type of measurement is shown in Fig. 4. For a permanent record, the oscilloscope screen may be photographed. Otherwise, a graphic recorder may be used with a low-pass filter and d.c. amplifier as used in the reverberation-time measurement system shown in Fig. 6. In addition to the transient acoustic characteristics of the room, this system also gives considerable information concerning echoes and the location of the various reflecting surfaces which give rise to echoes and large-scale reflections.

The signal wave shapes are shown in more detail in Fig. 5, to give a better indication of the type of data obtained with this method of measurement. The output of the audio oscillator is a continuous sine wave which may be set to any frequency at which the acoustic characteristics are desired. The switching and synchronizing circuit contains a gating mechanism (either a motor-driven cam-operated switch or an electronic gating circuit) which permits the signal through in pulses as shown in Fig. 5B. The signal pulse length is adjustable from 0 to 50 milliseconds duration and is repeated at intervals of about 1 second, so that the reflected sound decays to a negligible value before the next impulse. The horizontal time scale on the oscilloscope screen can be set for a sweep time of 0.5 sec. across the face of the screen. (If a graphic recorder is used, the switching and synchronizing circuit will be set for just one signal pulse, and the recorded response will be the response to this one pulse.) The type of signal received by the microphone consists of the direct sound pulse plus whatever reflections there may be from any parts of the room, as shown in Fig. 5C. By measuring the time taken for any reflections to arrive at the microphone after the direct pulse, and by actually laying out and plotting the various possible sound paths between the loudspeaker and the microphone in the room under test, the location of the various reflecting surfaces can readily be determined.

In practice, each measurement should be taken at three different positions at each location in the room, and at several different frequencies over the entire audio-frequency spectrum. A total of at least 10 to 15 different pulse reflection measurements should be averaged for each location. This type of averaging will tend to cancel out any spurious spatial or frequency effects.

Part 2 of this article will include a discussion of such items as noise level, sound power output, frequency response, and room acoustics.

(To be continued)

Special

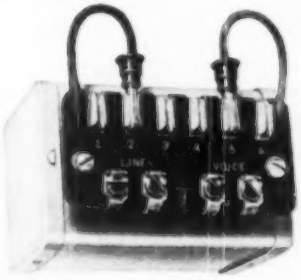
TRANSFORMERS

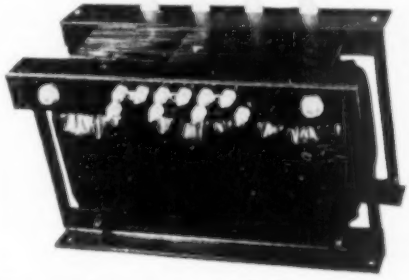
TO MEET UNUSUAL SPECIFICATIONS

The manufacture of "tailor-made", one-of-a-kind transformers, and small runs of custom-made specialty units, are important features of NYT service. A staff of engineering and production experts will translate your most exacting specifications into the components you require.

Above: Special DC power supply unit, input 115 volts 60 cycles—output 2500 volts filtered DC at 5 MA.

Right: A high quality speaker line auto transformer, used in multiple speaker installations to adjust volume and impedance for each individual speaker.





Left: A three phase high voltage plate transformer, weighing over 300 pounds. Rectifier output is 11 KVA DC (7000 volts at 1.5 amps).

The transformers illustrated show only three of the many which have been developed or manufactured by New York Transformer Company for special applications in radio, television and electronics. No matter how unusual your specifications, NYT will build transformers to meet them! Special facilities also include the manufacture of hermetically sealed units to meet current JAN T-27 and other government specifications; and specially treated, lightweight, uncased units for airborne equipment.

Let us know about your specifications and development problems. NYT experts and engineers are at your service.

NEW YORK TRANSFORMER CO., INC.
ALPHA, NEW JERSEY

NEW PRODUCTS

MERCURY ARC LAMP

Huggins Laboratories, 738 Hamilton Ave., Menlo Park, Calif., has announced the Ames Type-A mercury arc lamp

for light source in interferometers, Schlieren optical systems, shadowgraphs, monochronometers, and in high-speed photography. Light intensities of 90,000 candles per square centimeter can be reached at maximum brilliance with these units.

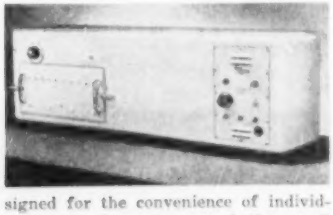
Arc dimensions are 2.85 cm. (1.125 in.) by 1 mm. (0.039 in.). Cooling is accomplished with ordinary tap water requiring 2½ gallons per minute, and average life at rated maximum brilliance is five hours.

Shown are the lampholder with lamp extracted, and in the background, the fully-controllable a.c. power supply. Light output is 65 lumens per watt; power input is 2 kw.; 1.2. amp. at 1750 volts.

TEMPERATURE TEST CHAMBER

A compact, economical, and convenient temperature-controlled chamber for the rapid performance of ambient temperature tests is now being produced by *Statham Laboratories, Inc.*, 9328 Santa Monica Blvd., Beverly Hills, California.

The Model TC-1 Temperature Test Chamber is completely portable and self-contained and is especially de-



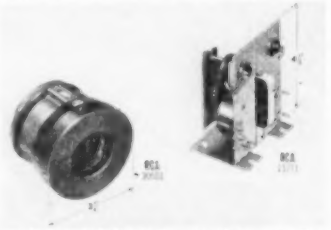
signed for the convenience of individual research workers and the small laboratory unit as well as for the production line tests of all types of small products.

The unit is fully insulated and consists of a completely sealed inner chamber and outer cabinet of welded dural construction.

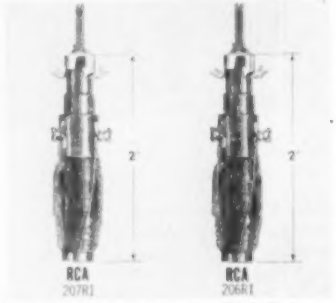
COMPONENTS FOR DEFLECTION SYSTEMS

Four new components for use in 10-inch and 12-inch television receivers having deflection systems designed to use the horizontal-deflection amplifier tube 6AU5-GT and the high-voltage rectifier tube 1V2, are now being offered to equipment manufacturers by *RCA*'s Tube Department, Harrison, N. J.

These new components, designed to operate efficiently with each other and



with the 6AU5-GT and 1V2, are Deflecting Yoke, Type 205D1; Width Control, Type 206R1, Horizontal Linearity Control, Type 207R1; and Horizontal-

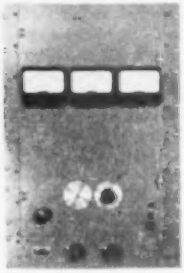


Deflection-Output and High-Voltage Transformer, Type 217T1.

The 205D1 magnetic deflecting yoke is intended for use with picture tubes having a deflection angle up to about 60° and operating at an anode potential up to 12 kilovolts. The 217T1 is designed for use with a single 6AU5-GT driver tube and with two 1V2 rectifier tubes in a voltage-doubler arrangement to supply a d.c. output voltage up to 12 kilovolts.

R.F. PHASE MONITOR

Model 109 high-precision phase monitor for measuring phase relations at radio frequencies was recently an-



nounced by *Clarke Instrument Corporation*, 910 King St., Silver Spring, Md.

According to reports, the instrument has an absolute accuracy of ±1 degree and resolution and repeatability of ±0.1 degree. Phase is read directly from two dials calibrated in 0.1-degree increments. The instrument continuously and automatically indicates the phase difference and requires no manipulation on the part of the operator.

Model 109 Phase Monitor requires 28 inches of panel space and is supplied with finishes to match those used by the various manufacturers of transmitting and associated equipment.

PULSE TRANSFORMERS

Raytheon Manufacturing Company, Waltham, 54, Massachusetts, is offering a complete line of pulse transformers suitable for use in driver circuits as blocking oscillator or interstage units.

A chart giving complete data on many of *Raytheon's* pulse transformer designs is available upon request. Write for DL-K-315, and address request to Department 6460-NR2.

MINIATURE RESISTORS

International Resistance Co., 401 N. Broad St., Philadelphia 8, Penna., has added to its line of BT Insulated Resistors two new miniature units. Type BTR at ½ watt meets JAN-RC10 specification and type BTB at 2 watts is equivalent to JAN type RC40.

Like all Advanced Type BT's, these resistors are protected against moisture

by a phenolic resin housing molded at high pressure and copper leads are securely anchored inside insulation and heavily tinned for easy soldering.

Full data in catalog form is available by writing the company.

UHF OSCILLATOR

The Model 112 u.h.f. oscillator announced by *Measurements Corporation*, 116 Monroe St., Boonton, N. J., covers the frequency range of 300 mc. to 1000 mc. The frequency calibration is accurate to ±0.5%.

Model 112 has a maximum output voltage, varying with frequency, between 0.3 volt and 2 volts, and provides

a tunable signal source between 300 mc. and 1000 mc. for measurements and testing such as tracking and alignment of u.h.f. receivers; standing wave measurements, transmission line measurements, antenna pattern measurements, impedance measurements and other applications.

ONE HALF OCTAVE FILTER

The Applied Acoustics Model SA-2 one-half octave filter is now available from *Gertsch Products, Inc.*, 11846 Mississippi Ave., Los Angeles 25, California.

Each filter is comprised of separate high and low pass filters each having seventeen different cutoff frequencies ranging from 37.5 cycles per second to 13,600 cycles per second in one-half octave steps. Selection of each cutoff frequency is made by push-button switches providing 203 useful positions.

The unit is available either in rack panel or carrying case and weighs 87 pounds.

COLOR SENSITIVE INSTRUMENT

A color-sensitive device which breaks up a light beam from any source into its spectrum, measures the relative spectral energy at each wavelength, and makes a permanent record of the measurements in the form of a graph has been announced by *General Electric's* Special Products Division.

Designated a "recording spectroradiometer," the instrument consists of a grating monochromator, photometer recorder, and power supply. The spectroradiometer measures 25 x 27 in. x 23 in., weighs 150 lbs., and can scan the complete spectrum from 230 to 650 millimicrons at speeds varying from 1 to 10 minutes, depending upon the nature of the spectrum.

Additional information on this device is contained in publication GEC-604 which is available to readers from *General Electric Co.*, Schenectady 5, N. Y.

TRANSFORMER CORE MATERIAL

Ferroxcube is the new transformer core material introduced by *North American Philips Company, Inc.*, 100 E. 42nd St., New York 17, N. Y. It is a ferromagnetic ferrite which reduces electrical losses in components such as horizontal output transformers of the type used in television receivers; in intermediate frequency transformers such as are used in superheterodyne circuits and in amplifier transformers for long distance wire communication circuits. It is applicable also in other circuits requiring low-loss inductors, coupling transformers and intermediate frequency transformers.

Ferroxcube is said to be extremely adaptable in molding and lends itself readily to the production of unusual or difficult shapes and is now available from *Philips* in a number of standard shapes or in custom shapes to meet manufacturers' requirements.

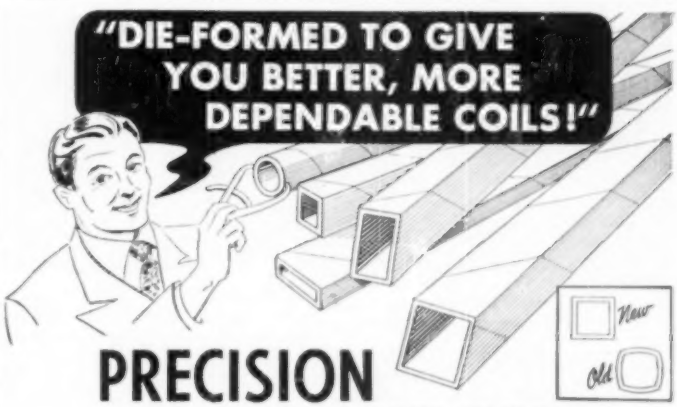
D. C. CHOPPER

In response to a demand for a Chopper which will operate from d.c., *Stevens-Arnold, Inc.*, 22 Elkins St.,

South Boston, Mass., has announced the availability of their line of Self-Excited Choppers.

These Choppers offer modulation/de-

(*Continued on page 30*)



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NEWS BRIEFS

PHYSICAL SCIENCE INTERNSHIPS

An integrated work-study program, beginning at the college-sophomore level, has been established by the National Bureau of Standards which offers vacation-time employment and graduate

fellowships to outstanding students in science and engineering to broaden their undergraduate or graduate training.

Dr. L. L. Marton is shown demonstrating the operation of the electron microscope to a group of Science Aids in the Bureau's electron physics laboratory.

This program permits the student to alternate periods of full-time study with actual experience in his chosen field, supplemented by on-the-job training and orientation courses at the Bureau.

Information regarding qualifications for appointment may be obtained from the Personnel Division, National Bureau of Standards, Washington 25, D. C.

ELECTRO HAS NEW PLANT

Electro Products Laboratories, pioneer manufacturers of Electro battery eliminators for radios, has a new location at 4501 North Ravenswood Ave.,

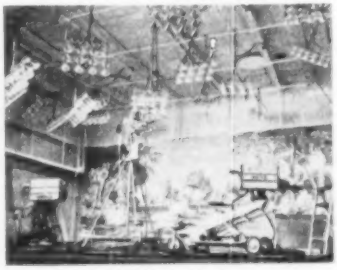
Chicago, Illinois, where both manufacturing and servicing facilities will be improved. Expanded production facilities are also expected to improve delivery on the Pressuregraph and Syncromarker.

Spacious display rooms are designed for displaying and demonstrating electronic instruments, and a staff of factory trained technicians is ready to offer a systematized, highly efficient service for quickly repairing electronic instruments.

PACKAGED TV STUDIO LIGHTING

The newest improvement to the modern television studio is *RCA's* packaged studio lighting system designed for use with television studio cameras. Among the items featured are high-intensity fluorescent banks, high-intensity spots, and incandescent banks to meet all studio lighting requirements.

All lights can be rotated 360° horizontally and 170 degrees vertically.



They are designed for pyramid-mounting on studio ceilings, and all are mechanically controlled through silent-operating fairleads that terminate in a central control board.

Shown is a typical studio layout using the packaged studio lighting system which is available through the Broadcast and Television Studio Equipment Section of the *RCA* Engineering Products Department, Camden, N. J.

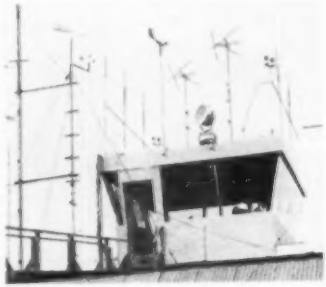
TV MONITOR REGISTERED

Television Utilities Corporation's TV monitor has been registered under the trade-mark "Private Eye." The first 30 units have been undergoing tests for many weeks at broadcasting stations, the company reports, with good results.

According to the manufacturer, these monitors will match the performance of units costing three times as much and will stand any test required by engineers. Some of the equipment incorporated into this low priced unit is a foolproof synchronizing system, a video frequency response out to 4.5 mc, plus or minus 1 db. or better, and is equipped to operate on a wide range of input voltages.

CONTROL TOWER INSTALLATION

A compact, modern control tower which aeronautical engineers expect will set the pattern for future installa-

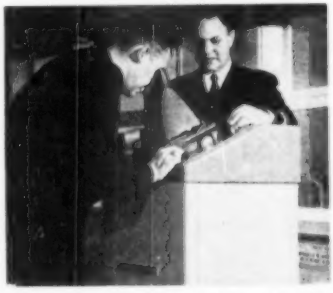


tions has been installed at the Reno, Nevada airport. Constructed by *United Air Lines* and operated by the CAA, the tower features polarized angled windows to eliminate glare, v.h.f. receivers and transmitters on all frequencies for contact with private, military and commercial aircraft, and a counter device to keep daily totals of all planes using the field.

Seen in the photograph are the two "spider web" type antennas for v.h.f. transmission, obstruction lights, anemometer, beacon light, and a flashing light gun to direct aircraft with no radio receivers.

MARITIME STUDENTS STUDY RADAR

A *Westinghouse* three-centimeter radar set has been installed at the Alameda, California, Training Station of the U. S. Maritime Service to give



students a thorough training in the theory and operation of radar, as well

as scope interpretation and radar navigational techniques. Students receive first hand experience under simulated marine conditions and are given approximately eight hours of practical instructions using the radar set.

Left, Lt. Commander Jack Halpern, instructor in charge of radar and loran classes, is showing a student how to adjust the brightness of the range markers.

The *Westinghouse* radar set, consisting of two parts, has a 50 kw. nominal peak power output. The antenna, on the top of the "deck house," is of the enclosed radome type.

MAST FOR PROBING OF TRANSONIC SPEEDS

G. M. Giannini & Co., Pasadena manufacturer of flight test instruments for supersonic aircraft, has designed a new instrument mast for *Northrop Aircraft, Inc.* which delivers its information by radio telemetering to ground recorders.

Housing self-contained temperature, speed, pitch and yaw instruments, it is expected to reduce lag errors seen in

conventional cockpit dial instruments operated by air pressure lines carried in a probing mast. Telemetered reactions of instruments in the *Giannini* mast are flashed to recorders at the speed of light.

ELECTRONIC DISPATCHER FOR ELEVATORS

Engineers of the *Westinghouse Elevator Division*, Jersey City, N. J. have developed sensitive vacuum tube devices to accelerate the automatic dispatching of high speed elevators.

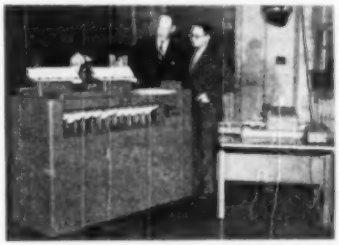
These electronic circuits, which transmit thousands of split-second impulses every hour, have been incorporated into the *Westinghouse* Selectomatic elevator control system to integrate cars, floors and push-button calls into a smooth flow of service to all floors.

First installations of the system will be made in the Merchants Exchange, Memphis, Tenn., and the projected 39-story Mellon-U. S. Steel skyscraper at Pittsburgh, Pa.

Two of the new developments include an electronic timer which serves as the core of the dispatching system, and an electronic counter which insures adequate service on the lower floors when regular low-zone cars have been speeded up to aid service on upper floors.

CENSUS MACHINE DEMONSTRATED

A machine which combines in one operation the simultaneous functions of classifying, counting, accumulating,



and editing and then prints the statistical data resulting from groupings of information was recently demonstrated at the Washington headquarters of the Bureau of the Census.

The Electronic Statistical Machine, which was developed by *International Business Machines Corporation*, has a capacity up to 10,000 units in each of 60 different classifications while simultaneously sorting the cards into predetermined groups at the rate of 450 cards a minute.

Mr. Louis H. LaMotte, *IBM* Vice-President, is shown making the presentation to Dr. Philip M. Hauser, right, Acting Director of the Bureau of the Census.

U. OF MASS. ENGINEERING LAB

The School of Engineering at the University of Massachusetts recently dedicated its newest addition, The Gunness Engineering Laboratory, named for Christian I. Gunness, late head of engineering at the university.

The building contains classrooms and laboratories for the departments of civil, mechanical and electrical engineering, servicing the needs of about 500 students majoring in these fields.

At a cost of $475,000, the building contains a double classroom seating 100 students, five staff offices, a main office and quarters for the maintenance staff.

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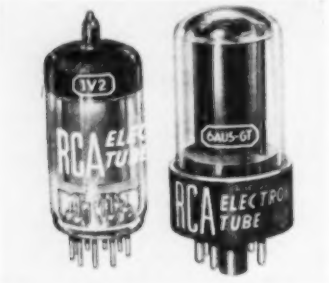
NEW TUBES

RCA TV TUBES

Two new tubes which will, according to reports, provide high efficiency operation of horizontal deflection systems



for ten-inch and 12-inch picture tubes are now available from the Tube Department, *Radio Corporation of America*, Harrison, N. J.

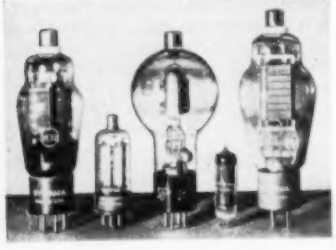
The 6AU5-GT is a high-perveance, beam power amplifier of the single-ended type. Its features include low mu-factor, high plate current at low plate voltage, and a high operating ratio of plate current to grid-No. 2 current. A power supply of 250 volts, or less, is all that is required for a receiver utilizing such a deflection circuit and the 6AU5-GT.

The 1V2 is a high-voltage, half-wave rectifier tube of the single-ended, 9-pin miniature type. When used in a doubler circuit which is transformer coupled to a horizontal-deflection circuit employing the 6AU5-GT, the 1V2 is especially suited for rectifying the high-voltage pulses provided by the transformer.

SYLVANIA TUBES

Transmitting Tubes

Sylvania Electric Products Inc., 500 Fifth Ave., New York 18 now has available five transmitting tubes for amateur, mobile and portable applications. Tubes in this group include two power triodes, a v.h.f. beam power amplifier, a pentode power amplifier oscillator and a miniature beam pentode.



Types 811A and 808 power triodes are suitable as a class B a.f. power amplifier and modulator; for plate modulated r.f. power amplification in class C telephony; as a self rectifying amplifier; and as a class C amplifier.

The v.h.f. beam power amplifier, type 2E24, is designed for use as a plate modulated r.f. power amplifier in class C telephony and as an r.f. power amplifier and oscillator in class C telegraphy.

The pentode power amplifier oscillator is type 2E22 for class C r.f. amplifier or oscillator service and as a suppressor modulated class C amplifier. The miniature beam pentode, type 2E30 is suitable for use as a class A1, AB1 or AB2 a.f. power amplifier and modulator; r.f. power amplifier and oscillator in class C telegraphy; and as an r.f. power amplifier in class C telephony.

Receiving Tubes

Three new receiving type tubes have also been announced by *Sylvania*. They

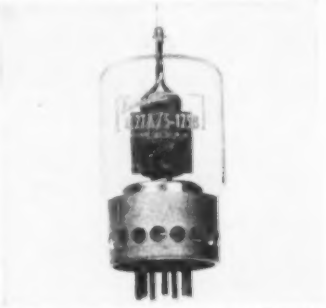
are an audio frequency amplifier, type 12AY7, an r.f. amplifier for television, type 6BC5, and a horizontal deflection amplifier for television, type 6BQ6GT.

Type 12AY7 is a T6½ miniature, medium-mu duotriode particularly suitable for use in the first stage of an a.f. amplifier where absence of noise and microphonism is desirable. The r.f. amplifier is a T5½ miniature sharp cut-off pentode having high mutual conductance, designed for r.f. and i.f. amplifier applications in television receivers. Type 6BQ6GT has been designed and processed for transformer operated sets where high peak interelectrode voltages are encountered.

REDESIGNED PENTODE

The Application Engineering Department of *Eitel-McCullough, Inc.*, San Bruno, California, has announced a radically redesigned 4E27 type pentode including such features as a moulded-glass header, shell type base, low-loss leads, non-emitting grids and a Pyrovac plate.

Designated 4E27A/5-125B, its physical size and basic electrical characteristics make it directly interchangeable



with type 4E27. It is rated at 125 watts plate dissipation and although designed for v.h.f. service, is well suited for television service and air-navigational aids, as well as for general r.f. and audio applications.

GE TUBES

Wide-Angle TV Tube

Production in limited quantities on a new wide-angle 16-inch metal television picture tube has been announced by *General Electric's* plant in Syracuse, New York.

Type 16GP4 is five inches shorter than conventional tubes of this size to allow for development of more compact home receivers for the larger picture. Also featured is a "filter-glass" face plate which is said to improve picture contrast and clarity by reducing halation and cutting down reflections from surrounding light sources.

Miniature Tube

Also announced is the 6BC5 miniature tube designed primarily for use as a radio-frequency and intermediate

frequency amplifier in television and FM receivers now in production.

The 6BC5 is an improved version of the 6AG5 and is interchangeable with that tube. The chief difference is an increased transconductance which was obtained with a plate voltage of 250 volts and a screen voltage of 150 volts, thus raising the transconductance from 5000 to 5700 micromhos.

V. H. F. Tank Design

(*Continued from page 9*)

well at low frequencies and where the tube interelectrode capacities are small. At higher frequencies, or with tubes having high interelectrode capacities, the added tuning capacity often results in sharply reducing the effective physical length of the tank and a consequent reduction of efficiency.

2. A variable shorting bar provides a tuning method which is essentially a means for electrically lengthening or shortening the tank to the desired frequency. While its approach is simple and straightforward, the mechanics for smooth positive operation may become somewhat involved. The mechanics of the shorting bar action must also assure that there will be no arcing or appreciable wear at the shorting points. Since these parts are usually silver-plated this requires a heavier plating of silver because of the wear encountered.

3. Varying the surge impedance of the tank is being used advantageously in several pieces of commercial equipment which are now on the market. Fig. 4 shows the power amplifier of a *Gates* 3 kw. FM transmitter. This was the first commercial transmitter to utilize this method of tuning.

As was shown in Eqt. (4), the resonant frequency of the tank circuit is also dependent on the characteristic surge impedance. The characteristic surge impedance is lowered by the presence of a metal plate or plane parallel to the tank. As this plane is brought closer, the surge impedance is rapidly lowered which results in a consequent increase in resonant frequency. Refering to Fig. 5, it will be seen that in practice this metal plate or vane is bent in a "U" shape and pivoted at the shorted end of the tank. The top end is swung in to increase the frequency and swung out to decrease the resonant frequency. This has the obvious advantages of eliminating all r.f. wiping contacts, while simultaneously providing a simple positive mechanical arrangement which maintains complete circuit symmetry. In common with the shorting bar method, the physical length of the tank is kept long enough to maintain highest efficiency.

4. The introduction of a variable dielectric material between the tank legs or elements provides another method of tuning a tank circuit. The dielectric serves to decrease the propagation constant and change the surge impedance. Probably a pivot arrangement similar to Fig. 4 would serve as a convenient mechanical method for varying the dielectric between the legs of the tank. To the writer's knowledge there is yet no commercial adaptation of this on the present market.

Since the tank circuit and its shielding are so closely related, the design of the tank should encompass this as well. An effective shield enclosure of the tank and/or tubes provides an often mandatory degree of isolation required for stability and freedom from oscillations which might otherwise occur. Often this enclosure can conveniently serve as part of the cooling system. The radiation losses from a balanced type push-pull tank may be reduced to a negligible amount by using highly conductive shielding material. Fig. 5 illustrates such an enclosure. It is interesting to note that a high degree of isolation for increased stability is provided by this construction, as is an efficient tube cooling system. Further examination will disclose that flat type tank elements are employed and the variable surge impedance method of tuning is used in conjunction with semi-fixed capacitor plates at the bottom of the tank. The tuning vane affords a fine or vernier tuning range of several hundred kilocycles, while the capacitor plates serve to extend the lower frequency limit enabling coverage of the complete 88-108 mc. FM band.

Since the flow of r.f. currents is confined to the surface at v.h.f., due to skin effect, it is paramount that this surface present low r.f. resistance. Silver offers the lowest resistance and is to be preferred. It is, however, quite expensive and for this reason silver plating is usually employed for the conducting surface. As brass takes a fine even plating and is very machineable, it is often used.

It is necessary that the plating be smooth with a highly polished surface as a spongy plated surface is little better than the brass itself.

In laboratory and experimental work the polished brass or copper surface will often suffice. A coating of very thin clear lacquer will assist materially in keeping the surface bright and free from tarnishing.

Aluminum also has high conductivity. While its conductivity is not quite as good as that of silver, the writer has used it successfully in several experimental models. Fig. 1 illustrates one such experimental unit in which sheet aluminum was used as the tank elements.

Aluminum is favored by several manufacturers for fabricating the shield enclosures of the plate and grid tanks of their equipment. The plate tank enclosure of Fig. 3 is of all aluminum welded construction. Aluminum is easily and beautifully finished by a simple etching process. A thin coating of clear lacquer will retain the finish almost indefinitely.

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TECHNICAL BOOKS

"ACOUSTIC MEASUREMENTS" by Leo L. Beranek, S.D., D.Sc. (Hon.). Published by *John Wiley & Sons, Inc.*, 440 Fourth Avenue, New York 16, N. Y. 914 pages. $7.00.

Dr. Beranek, vice-president of the Acoustical Society of America, has written this clear and concise exposition of acoustic measuring techniques as an aid to five main groups of research workers; the acoustic physicist, the communications engineer, the psychologist, the otologist, and the industrialist.

It is an encyclopedia of acoustic measuring techniques which presents the source of the theory of many electroacoustic phenomena, and a detailed description of the basic types of acoustic measuring devices. Topics range from the calibration of microphones and loudspeakers to evaluation of over-all audio systems, and to chapters on the audiometer, speech articulation tests and the sound level meter.

The material in this book, which is one of the few of this nature published, is of prime importance to all concerned with acoustics in any phase of their work or study and will be equally valuable to the graduate student or research worker.

"ELECTRICAL ENGINEERS HANDBOOK. Volume 1, Electric Power, by Harold Pender and William A. Del Mar. Published by *John Wiley & Sons, Inc.*, 440 Fourth Avenue, New York 16, N. Y. 1698 pages. $8.50.

This is the fourth edition of Pender's "Handbook for Electrical Engineers," which first appeared in 1914. This fourth edition, as was the third, is divided into two volumes: one on electric power and the other on electrical communication and electronics. Tables and fundamental theory are duplicated in the two volumes in order that each might be complete and independent of the other.

Seventy-one specialists in their respective fields have contributed to this edition which is entirely rewritten. Subjects including circuit stability and symmetrical components, electronic rectifiers, aircraft equipment, heat pumps, servomechanisms, permanent magnets, plastic insulating materials, and induction and dielectric heating apparatus, all of which have become of increased importance, are thoroughly covered.

Although a greater degree of specialization in the various phases of electrical engineering have necessitated enlarging both volumes, these books have been kept compact and readable.

"INDUSTRIAL ELECTRONICS" by Andrew W. Kramer. Published by *Pitman Publishing Corporation*, 2 West 45th St., New York, N. Y. 311 pages. $6.00.

Here is a valuable book for the practical man in industry who is interested in all the various new uses of electronics. A complete description of electron tubes, how they were evolved, and how they work is given as an invaluable aid in determining how the new methods and equipment can be used for improving maintenance and operations in the industrial plant.

The book begins with a brief historical background and a consideration of electron theory presented in a simple, clear, language. The fundamental principles of electronics are explained without the use of mathematics and the application of these principles in industry is clearly shown. The book also supplies necessary information on the operation and maintenance of electronic equipment.

The basic material of this volume appeared first as a series of articles on electron tubes in *Power Plant Engineering*. All the original material has been revised and a great deal of new material added to bring the entire work up to date.

D. C. Amplifier

(*Continued from page* 13)

to ground). In this case, it can be shown that the gain of one stage working into infinite load impedance is one-half the amplification factor of the tube used, whether the cathode resistors are bypassed or not. A formula giving the gain for finite load impedances will be given later. This formula shows that bias cells may be useful to avoid degeneration in the cathode resistors.

The use of pentodes with a floating power supply permits the realization of extremely high d.c. stage gains (up to 4000) into loads of high impedance, such as tube grids or cathode-ray deflection plates. Fig. 2 shows how constant screen voltages of about 70 volts may be obtained by means of small neon bulbs.

Many variations on the original scheme are possible. As an example, Fig. 7 shows a stable low-impedance driver circuit with output at zero d.c. level. This is the equivalent of a compensated cathode follower, and is useful to drive recorders, indicating devices, and similar instruments.

Application of Feedback

Since both input and output voltages of the new amplifier constitute positive and negative excursions with respect to a zero d.c. reference level, the application of feedback over one or more stages is especially easy. In Fig. 3 regeneration over two stages and degeneration over three stages is shown; this is a typical balanced feedback circuit and reduces distortion in the output stage to a minimum. Fig. 2 shows how a high-gain pentode stage is stabilized through the use of inverse feedback.

Experimental Results

An electronic voltmeter connected to the output of the three-stage amplifier in Fig. 3 did not show any noticeable deflection when the B supply was switched *on or off* after careful balancing. Changes of 20% in the filament voltage had similarly little effect on the balance. Long-term drift seems to depend largely on the stability of the resistors used in the circuit.

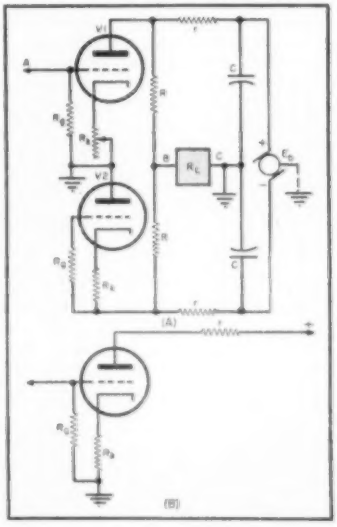
Circuit Analysis of the Bridge-Balanced Amplifier

It can be shown from the equivalent circuit of the amplifier that the circuit design equation for the case of the floating power supply is:

$$E_o = \frac{-\mu R_L}{(\mu+1)\ R_k + R_p + 2R_L + R}\ E_i$$

which is independent of plate and filament voltages. For very large load re-

Fig. 6 (A) Simplest form of the new amplifier. Power supply is shown with centertap grounded. (B) Conventional amplifier stage for computing gain. The gain of (A) is exactly half that of (B).



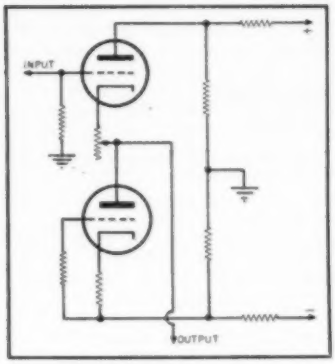


Fig. 7. A stable low impedance driver circuit with output at zero d.c. level.

sistances R_L may be expressed as:

$$\frac{E_o}{E} \approx -\frac{\mu}{2}$$

From the equivalent circuit of the amplifier with a center-tapped power supply, it can be shown that the gain is:

$$E_o = \frac{-R_L r \mu}{(R_p + R_k(\mu+1))r + Rr + 2R_L(R_p + (\mu+1)R_k + r)} E_i$$

for $R_L = \infty$, this reduces to

$$E_o = \frac{-E_i}{2} \frac{\mu r}{R_a + (\mu+1)R_k + r}$$

which is just one-half of the gain of the amplifier shown in Fig. 6B.

For a perfectly balanced condition of the bridge, the effect of slow plate and filament variations on the output will be very small.

The engineer, physicist and experimenter will discover many new uses for this simple circuit which is easily built with a minimum of circuit components and is particularly well-suited to portable battery-operated applications.

A few modern applications of the new d.c. amplifiers are suggested by the illustrations presented.

Acknowledgement

The project described in this article was carried out in May, 1947, under a grant from the Applied Mathematics Division, Brown University, Providence, R. I. The writers wish to thank Professors Krumhansl and Prager for their encouragement and cooperation, and to thank Mr. G. Heckler for his able assistance with the laboratory work.

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2. *Artzt, Electronics, August, 1945.*
3. *Gingston, Electronics, March, 1944.*
4. *Gingston, IRE Proceedings, November, 1948.*
5. *Ruggerini et al., IRE Proceedings, May, 1947.*

Personals

WILLIAM B. BERGEN, director of the Special Weapons Department of *The Glenn L. Martin Company*, has been named chief engineer in charge of the company's engineering activities. A graduate of the Massachusetts Institute of Technology, Mr. Bergen received the Lawrence Sperry Award of the Institute of the Aeronautical Sciences in 1943 for his theoretical and experimental investigations of dynamic loads on aircraft.

R. T. CAPODANNO has been appointed Director of Engineering at *Emerson Radio and Phonograph Corporation*, New York. Mr. Capodanno was previously connected with the University of Illinois as engineering adviser on technical devices for the hard-of-hearing, brain wave studies and spinal work. He is a member of RMA's Sound Systems Committee and has served as an engineer on communications with *Illinois Bell Telephone Co.*

DR. ALEXANDER ELLETT was recently elected vice president in charge of research by directors of *Zenith Radio Corporation*, Chicago, Illinois. Dr. Ellett, who has headed *Zenith's* research laboratories since 1946, was formerly head of Division 4 of the NDRC where he directed the development of the V-T proximity fuse for bombs and rockets for which he received the President's Medal for Merit. He was also formerly professor of physics at the University of Iowa.

CARL J. HOLLATZ, formerly vice-president of the *Belmont Radio Corporation*, has been retained as a consultant to the Sales division of the Tube Department of *RCA*. Mr. Hollatz will make his headquarters in Chicago. Prior to his connection with *Belmont*, Mr. Hollatz was Manager of the *Westinghouse Company's* tube operations in Indianapolis, and later President and General Manager of *Ken Rad Tube and Lamp Corporation*.

DR. THOMAS J. PARMLEY has been appointed to the staff of the National Bureau of Standards where he will do research in the x-ray laboratory of the Atomic and Molecular Physics Division. Before joining the Bureau in 1927, Dr. Parmley was a professor of physics at the University of Utah. He has done considerable research in nuclear physics, including investigations of the radioactivities of the heavier cobalt isotopes.

DR. FRANK B. JEWETT, for many years vice president of the *American Telephone and Telegraph Company* and former president of the National Academy of Sciences, passed away November 18. Dr. Jewett had been named to receive the 1950 medal of the Industrial Research Institute, Inc., in April.

D. C. Voltmeter

(*Continued from page 7*)

mer Avenue, Newark 4, New Jersey—and used to seal electronic components into metal cans. The leakage resistance of these beads is quoted at 10,000 megohms after a salt spray test. Before this test and as normally received these

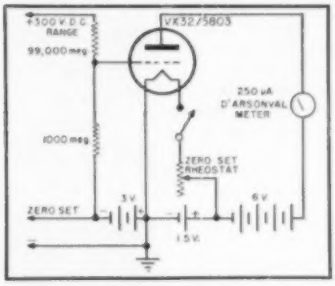


Fig. 3. Basic schematic of voltmeter. Basic voltmeter range is seen to be 3.0 volts full scale.

beads are of infinitely higher leakage resistance, probably on the order of 10^{12} ohms. To maintain this leakage resistance it is advisable to cover the bead surface with *Dow-Corning* DC4 if the instrument is to be used in a high humidity area or if other contamination is possible. Under no condition use any cleaning agent other than clean pure alcohol or carbon tetrachloride and a piece of clean cotton cloth, if contamination is suspected. If it is desired to use a plastic insulator then polystyrene should be used, but for the use indicated in this article a glass bead is to be preferred. Polystyrene is very difficult to clean and maintain in a clean state. It would require several pages to go fully into a cleaning technique for use with polystyrene but the following will generally prove adequate. Polish the polystyrene surface with ordinary paper towel to a brilliant surface. After installation wash the exposed leakage paths with carbon tetrachloride. If desired then coat with *Dow-Corning* DC4.

Electrometer tubes do not as a rule use over 6 volts on the plate, while the filament requires 1.1 to 1.5 volts with a filament current of 10 milliamperes. The plate current (VX32/5803) will be about 250 microamperes with zero bias and 6 volts plate supply. Two and one half volts bias will provide cutoff. For maximum sensitivity a plate current of 150 microamperes should be used and a balancing circuit utilized so that a plate current meter will indicate only the change in plate current. This will minimize any tube nonlinearity as well as provide very high gain. In cases where high gain and low drift are desired the filament should be lit a few seconds before the plate voltage is supplied. The input impedance on these circuits can be made so high that static electric charges, such as generated on a hair comb, can be measured.

One major factor which limits the usable input resistance is *RC*. In the design of these circuits, TIME in SECONDS to obtain a meter deflection is a product of resistance (in megohms)

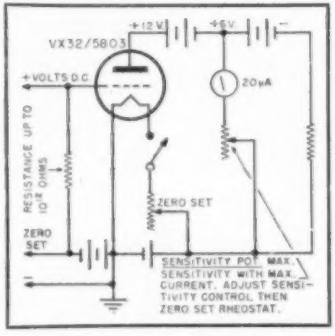
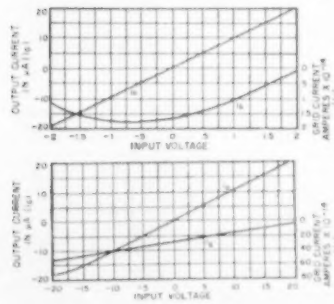


Fig. 4. An ultra-sensitive voltmeter.

times capacity in μfd. and is an important consideration. VX32/5803 electrometer tubes have an internal capacity of approximately 2.0 μμfd. An additional capacitance of 2.0 μμfd. can nominally be expected due to external wiring—even though great care is used. The product of 10^{12} ohms resistance times 4.0 μμfd. is some four seconds, 10^{11} (100,000 megohms) some 0.4 seconds. It is not considered good practice to have an instrument which requires over 1.0 second (*RC*) time, and it is preferable to have an *RC* time of 0.1 second. In actual practice time up to several seconds is not too objectionable providing the d.c. voltage to be measured is stable. To minimize capacity the electrometer tube should be in a probe (with its grid resistor) and an extension cable used to connect it to the D'Arsonval meter and batteries. Several circuits will be found in the text, any one of which will be suitable for measurements where very high input impedances are required.

Fig. 5. Calibration and grid current for the electrovolter circuit of Fig. 1. Top, 0-2 volt range; bottom, 0-20 volt range.


OUTPUT CURRENT IN μA (-Ig)
INPUT VOLTAGE
GRID CURRENT AMPERES X 10⁻¹⁴
OUTPUT CURRENT IN μA (-Ig)
INPUT VOLTAGE
GRID CURRENT AMPERES X 10⁻¹⁴

New Products

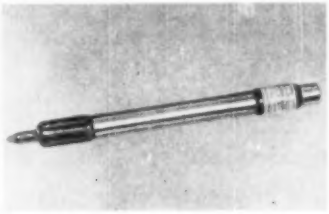
(*Continued from page 23*)

modulation in one unit, and are particularly well-suited for use in aircraft where there is a d.c. as well as an a.c. power source available.

A complete description of the Self-Excited Choppers appears in the company's Catalog No. 267 which may be obtained upon request.

RADIATION COUNTER TUBE

A new, thin metal wall Radiation Counter Tube for beta and gamma detection is now being manufactured by



Amperex Electronic Corporation, 25 Washington St., Brooklyn 1, N. Y.

Type 52N may be operated over a wide temperature range without affecting tube life or electrical characteristics, and accidental overvoltage will not harm this tube.

Complete data on the Radiation Counter Tube, Type 52N may be obtained by addressing an inquiry to Mr. Myron Smoller, Sales Engineer.

WELDING CONTROL EQUIPMENT

Westinghouse Electric Corporation, Pittsburgh, Pa., now has available two all-electronic, high-speed resistance welding control equipments for synchronous and non-synchronous operation. These equipments have no moving parts in power and control circuits except initiation and solenoid relays.

Basic control panels consist of the plug-in Rectox rectifier tube firing panel for non-synchronous units, or a heat-control firing panel for synchronous units. Space is also provided for the addition of auxiliary control panels such as a.c. forge timer, d.c. precision-type forge timer, wave-shape control, voltage compensator, initial-squeeze attachment, current regulator, temper sequence weld timer, dual weld attachment, interlocking relay attachment, dual weld interval attachment, and a Timatic control attachment.

Further information may be obtained by writing to *Westinghouse* at P.O. Box 868, Pittsburgh 30, Pa.

Antenna Pattern

(*Continued from page* 15)

taken when the equipment is used in measuring the pattern of an antenna on location. The principal advantage of measuring antenna patterns on location is the opportunity afforded to determine the effect of surrounding objects such as guy wires, smoke stacks, and other mounts.

Acknowledgment

The work described in this paper was carried out as a development program of the Naval Research Laboratory and a production engineering program of *Airborne Instruments Laboratory, Inc.*

Rugged Electron Tube

(*Continued from page* 11)

the tube structure as rigid as possible to avoid resonance with high-frequency vibrations. It is extremely important to employ low-strain designs at all points of glass-to-metal contact and to eliminate brittle materials wherever possible. It is often useful to carry out a theoretical analysis for an idealized structure approximating the structure of the tube under consideration. In this way, the designer can achieve a rough guide to the resonant frequencies of each tube element and an indication of whether or not a proposed design will be satisfactory.

High-Impact Shock Tests

Impact tests determine the ability of electron tubes to withstand rough handling and dropping. Shocks of this sort occur in shipment of tubes, in motor vehicles, in military operations, and in use with industrial equipment. Impact shocks result in tube failures of the same general type as those produced by vibration and resonance, but shattering of the glass envelope and breaking of brittle metal parts are more frequent.

The high-impact machine used at the Bureau consists of a test table, on which the tube is mounted, and a hammer suspended like a pendulum so that the energy imparted to the table will be a function of the angle from which the hammer is released. The table and hammer weigh about 75 pounds apiece, and the impact machine can test tubes weighing up to 25 pounds. Tubes may be mounted in any desired plane, and normal operating potentials or shorting indicators can be connected to the tube elements. Instantaneous accelerations up to a maximum of several hundred times the acceleration of gravity and down to a minimum of 50*g* may be readily selected. The duration of impact is less than a millisecond. Impact accelerations are measured with a quartz-crystal accelerometer and verified by means of streak photography.

Centrifugal Acceleration Tests

High-acceleration conditions are met principally in the application of electron tubes to electronic equipment in high-speed devices, where tubes receive large continuous forces for relatively long periods of time compared to the brief, transient-force conditions under impact. A tube which will withstand high accelerations must have great structural rigidity to prevent shifting and bowing of the various electrodes.

The motor-driven centrifuge now in use in the Electron Tube Laboratory of the Bureau can produce accelerations up to several thousand times the acceleration of gravity. Its rotational speed, as measured with a tachometer or with a stroboscopic pick-up, ranges up to 18,000 r.p.m. The centrifuge can be modified to increase the acceleration by evacuating the chamber so that the driven element will not be opposed by the resistance of the air. The speed of a centrifuge can be closely and easily controlled, making it possible to reproduce particular test conditions on different centrifuges. This cannot usually be done with other types of dynamic test equipment.

Objects weighing up to several ounces —and this includes almost all miniature and subminiature tubes—may be tested in the present centrifuge. As many as a dozen tubes can be placed in the chamber at one time. Tubes can be oriented at various angles to the direction of acceleration in order to study the differences in rigidity of components in different directions. Newer centrifuges permit connection of typical operating potentials to the tube elements so that the electrical performance can be studied during high acceleration. Centrifuges have been designed to give very high accelerations—the Beams type is notable in this respect. In the near future the Electron Tube Laboratory will place such a high-acceleration centrifuge into operation.

Centrifuge acceleration tests provide a good over-all quality check for electron tubes. The most common tube defects revealed by acceleration tests are high bending moments, inability of the glass envelope to support the internal structure, breaking of welds, bowing of elements, and interelectrode shorts. Taken together, the vibration, resonance, impact, and acceleration tests provide a useful picture of tube behavior when subjected to mechanical forces.

Testing and Design

The development of rugged electron tubes is a good example of the interdependence of testing and design. In a sense, the creation of rugged tubes is brought about through a series of successive approximations. The development of a rugged tube might begin by applying appropriate mechanical tests to an existing commercial type whose electrical characteristics suit the intended application. The results of these tests would show in what way this tube type fails to meet the ruggedness requirements. A preliminary revision of the tube design could then be made with the test results as a guide, and a hand-made model constructed in the model shop. The same tests could then be repeated for this experimental tube. Usually the tube would turn out to be a vast improvement over the commercial type, but in some respects it might not yet fulfill the necessary ruggedness requirements. At this point the designer would probably have a clear idea of the direction to take in order to achieve a satisfactory rugged tube. It might involve a search for better materials for use in some tube elements, new methods of fabrication adapted to eventual mass production, or better geometrical configurations and alignment of tube elements for maximum rigidity. The influence of each structural element on the over-all strength of the tube would be carefully considered. Thus, through a succession of several trial designs a suitable rugged tube would be evolved.

At present the cost of rugged tubes is about three or four times more than conventional tubes. But it is not unreasonable to expect that as more is learned about production methods and materials applicable to rugged tube types the cost will be much less and all preferred tube types will eventually be available in ruggedized form.

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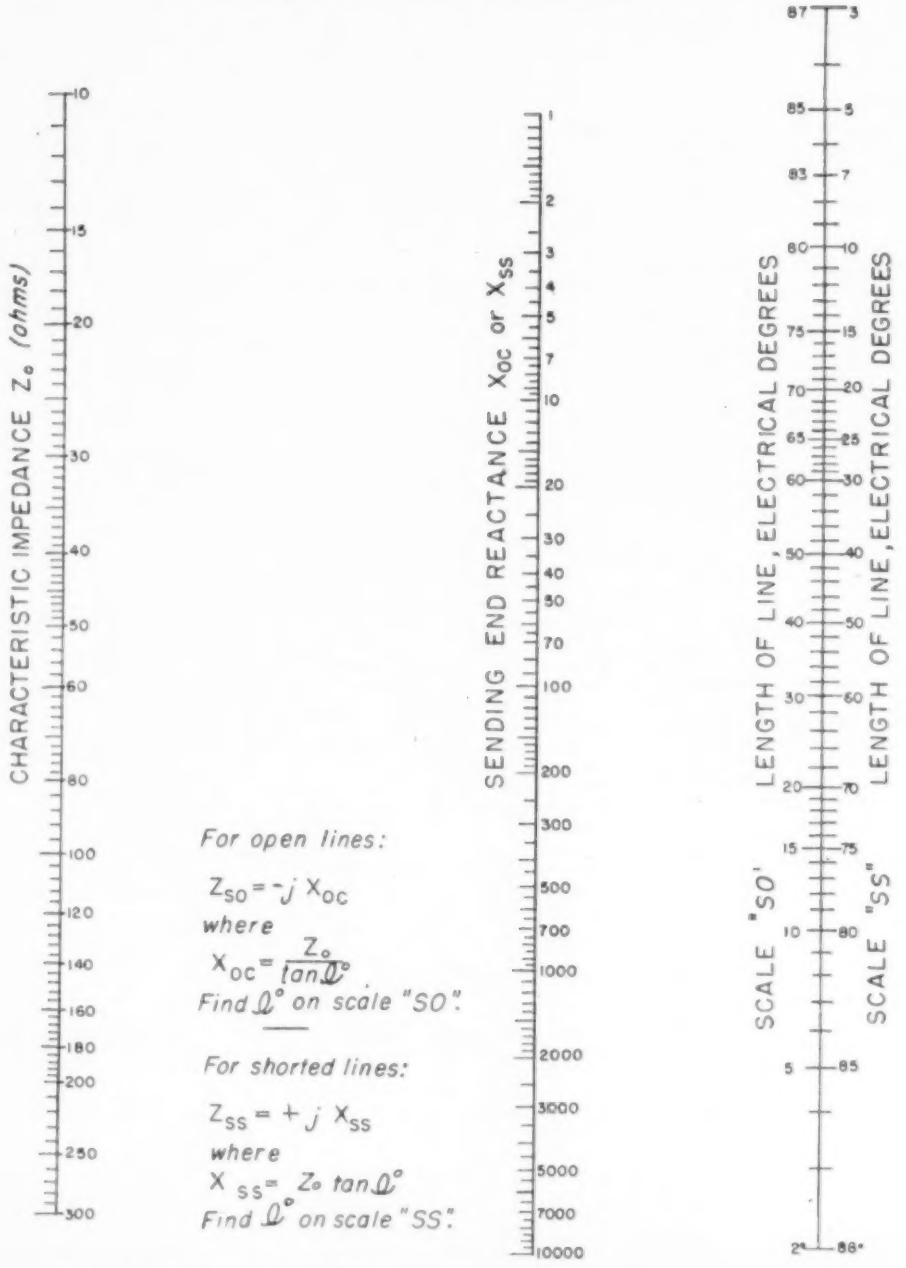
SENDING END IMPEDANCE OF UNIFORM LINE

This chart may be used to obtain input resistance of lossless shorted and open transmission lines.



For open lines:

$Z_{SO} = -j\, X_{oc}$

where

$X_{oc} = \dfrac{Z_o}{\tan \Omega^\circ}$

Find Ω° on scale "SO".

For shorted lines:

$Z_{SS} = +j\, X_{SS}$

where

$X_{SS} = Z_o \tan \Omega^\circ$

Find Ω° on scale "SS".

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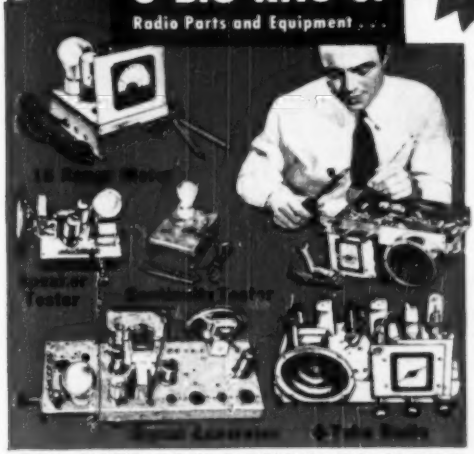

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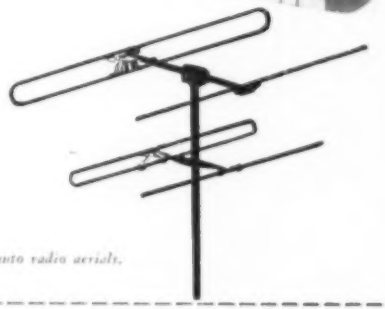

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Within the INDUSTRY

ROBERT A. SEIDEL has joined the *RCA Victor Division* as vice-president in charge of distribution. He resigned his post as vice-president and comptroller of the *W. T. Grant Co.* to assume his new duties.

He joined the *Grant* organization in 1940 as comptroller and was appointed vice-president in 1944. He is well-known for his activities in the National Retail Dry Goods Association, where he served as a member of the board of directors, chairman of the executive committee, and chairman of the Association's committee on government affairs. He was awarded the association's gold medal of honor in 1946 and a special citation of merit in 1949.

Mr. Seidel is a member of the board of directors of the American Standards Association and chairman of the Consumers Goods Committee. He will make the home office at Camden, New Jersey his headquarters.

* * *

NATIONAL ASSOCIATION OF ELECTRICAL DISTRIBUTORS will conduct a series of meetings covering the problems facing distributors of electrical appliances, television, and radios the early part of January in Chicago.

The meetings, which will be held at The Drake, find the association's Major Appliances Committee convening on January 11th, the Radio, Television, and Tubes Committee gathering on the 12th, and the Electrical Housewares Committee meeting on the 16th.

The schedule coincides with the Furniture Mart and Housewares Show being held concurrently in Chicago.

* * *

FRED D. WILSON was named president of *Capehart-Farnsworth Corporation* at a meeting of the company's board of directors held in New York.

Mr. Wilson brings to the *Capehart-Farnsworth* organization more than 25 years of experience in manufacturing and sales in the home appliance field of which 12 years were served with the *RCA Victor Division* of *Radio Corporation of America*.

In 1948 Mr. Wilson accepted a position as assistant to the president of the *Bendix Home Appliance, Inc.*, and shortly thereafter became executive vice-president. He succeeds Ellery W. Stone in the presidency. Mr. Stone will continue as a member of the board of directors and as president of the *International Standard Electric Corporation*, another *International Telephone and Telegraph Corporation* subsidiary.

* * *

AEROVOX CORPORATION has purchased for cash the entire outstanding stock of the *Electrical Reactance Company* which has plants at Franklinville, New York; Jessup, Pennsylvania; and Myrtle Beach, South Carolina.

Electrical Reactance Company, which will be operated as a wholly-owned subsidiary, will continue under the management of Charles E. Krampf, president. Mr. Krampf will also serve as a director of the parent company.

* * *

RALPH BRENGLE, general sales manager of *Potter & Brumfield*, has moved his office to Princeton, Indiana and will hereafter conduct sales from the company's plant there.

Since 1945 Mr. Brengle has maintained offices at 549 W. Washington Blvd., Chicago. The Chicago office will continue at the same address under John Newman for regional sales.

Potter & Brumfield has recently doubled its engineering and manufacturing facilities with the opening of the new Main Street Plant in Princeton.

* * *

ELECTRIC SUPPLY CORPORATION of Chicago has been appointed selective franchise distributor for the Chicago area by *John Meck Industries, Inc.* . . . *Pyramid Instrument Company* has named **KOEHLER-PASMORE COMPANY, ENGINEERING PRODUCT, NORTHWESTERN AGENCIES**, and **INDUSTRIAL SPECIALTIES SALES** as representatives of the firm. . . . **DAVID RANDOLPH** has been appointed music consultant for *Lafayette Radio* of New York. . . . **KARL HASSEL** has been elected to the post of secretary of *Zenith Radio Corporation* while **JOHN KUHAJEK** and **ALBERT J. FRANCZAK** have been named assistant treasurer and assistant controller, respectively. . . . **IRVING B. SHURACK** is the new regional manager in the New York Metropolitan area for *Trans-Vue Corporation* of Chicago. . . . **MAYFLOWER INDUSTRIES'** New Jersey division has been named Newark distributor for *Stewart-Warner* television and radio products. . . . **SUN RADIO AND ELECTRONICS COMPANY, INC.**, is the new jobber for *Peerless* transformers in the New York Metropolitan area. . . . The formation of **MARATHON**

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Does your radio give out with squeals and grunts? Then call the serviceman who displays the Sylvania sign. But some your radio needs expert care, the kind the fellow is trained
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Sylvania ads especially prepared to *boost your service* are telling 15,500,000 people from coast to coast all about the *valuable service* and parts you're offering them. Readers of these magazines are attracted to the lively cartoon-type ads, three of which are reproduced above. They tell them to stop at the Sylvania sign of dependable service . . . for the best radio and television repairs at the fairest prices!

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by JACOB H. RUITER, Jr.,

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4. Principles of Cathode Ray Tube Operation
5. Details of the Modern Cathode Ray Tube
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7. Power-Supply Circuits
8. Amplifiers, Attenuators, and Positioning Circuits
9. Time-Base Circuits

HOW TO USE IT ON THE JOB

10. Operation of the Oscilloscope
11. Interpretation of Basic Patterns
12. Auxiliary Equipment
13. Typical Applications in the Electronic Industry
14. Servicing A-M Radio Receivers
15. Servicing F-M Radio Receivers
16. Servicing Television Receivers
17. Use of the Radio Transmitter
18. Using the Oscilloscope in Teaching
19. Additional Industrial Uses of the Oscilloscope
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EASY TO UNDERSTAND

Each operation is carefully explained including the making of connections, adjustment of circuit components, setting the oscilloscope controls, and analyzing oscilloscope patterns. About 400 illustrations, including literally dozens of pattern photos, make things doubly clear.

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SALES COMPANY has been announced by Ben Willig and Eddie Deutsch. The company has offices at 466 West 42nd Street, New York. . . . **MARVIN W. SMITH,** president of the *Baldwin Locomotive Works*, has been elected a director of the *Westinghouse Electric Corporation*. . . . **L. J. N. DU TREIL,** a radio engineer for the FCC and its predecessors for the past 30 years, has retired from government service and will engage in the practice of consulting radio engineering in New Orleans. . . . **CHARLES W. COLEMAN** has been elected controller of *The Workshop Associates, Inc.* of Newton Highlands, Mass. . . . *American Television and Radio Company* has named **BENRAY DISTRIBUTORS** of Brooklyn as exclusive distributors of *ATR* auto replacement vibrators in the Flatbush area. . . . **THE FRANK W. TAYLOR COMPANY** of De-Witt, New York, will represent *Cannon Electric Development Company* in all New York counties north of Ulster, Sullivan, and Dutchess. . . . **EDWARD J. BACHER** is the new tube sales manager for initial equipment accounts in the Chicago area according to an announcement from *National Union Radio Corporation*. . . . **ALBERT E. KELEHER, JR.,** has been named manager of Raytheon's mobile radiophone sales. . . . **EDWARD E. SCHULTZ** and **EMERY L. HALL** have been appointed electronics engineer and mechanical engineer, respectively, for *Magnecord, Inc.* . . . **R. C. COSGROVE** has resigned as executive vice-president of *Avco Manufacturing Corporation*. He will continue as a member of the board and in a consulting capacity to the management. He will also continue to represent the *Crosley Division* in the RMA of which he is president.

* * *

ROLAND R. HAND has been appointed to the post of district radio sales supervisor for the Central New York State District of the *Westinghouse Electric Supply Company* with headquarters in Rochester, New York.

Mr. Hand, a native of Englewood, New Jersey, was formerly New York district manager for the *Motor Products Corporation* and was employed by *General Electric Supply Company* for some time as a district appliance sales manager.

* * *

ELECTRONIC INDICATOR CORP. has moved to new and larger quarters at 259 Green Street, Brooklyn 22, New York. . . . **INDUSTRIAL ELECTRONICS, INC.** has added a new laboratory to their facilities at 205 Donovan Building, Detroit 1, Michigan. . . . **FIDELITY CHEMICAL PRODUCTS CORPORATION,** manufacturers of industrial metal treating and cleaning compounds, has taken over its new quarters at 470 Frelinghuysen Avenue, Newark, New Jersey. . . . **RADIO ELECTRIC SERVICE CO.,** wholesale distributors of radio and television parts with headquarters in Philadelphia, has opened a new branch at 406 N. Albany Avenue, Atlantic City, New Jersey. It is their ninth unit. . . . **ALLIED ELECTRIC PRODUCTS, INC.** has moved its Chicago offices and warehouse to enlarged quarters at 426 South Clinton Street in Chicago. . . . **RUBANE RADIO SERVICE** has moved to 4903 Belair Road, Baltimore 6, Maryland.

* * *

ERLING G. FOSSUM has been appointed general manager of *Stewart-Warner Electric*, the company's radio and television division in Chicago.

An employe of the *Stewart-Warner Corporation* since 1926, Mr. Fossum fills the vacancy created by the resignation of Samuel Insull, Jr. In his new position he will be responsible for all phases of engineering, production, and marketing of radio, television, and other electronic products made by the company. He has been serving as assistant to the president and formerly was associated with the *Alemite Instrumeat and Heater* divisions as service manager.

* * *

C. T. LAWSON, vice-president in charge of sales for the *Kelvinator Division* of *Nash-Kelvinator Corporation*, was named president of the National Electrical Manufacturers Association (NEMA) at the association's annual meeting. He succeeds B. W. Clark of *Westinghouse*.

Serving with Mr. Lawson as vice-presidents are: C. W. Higbee of *U.S. Rubber Co.*, J. H. Jewell, *Westinghouse Electric Corporation*, James F. Lincoln, *The Lincoln Electric Company*, E. E. Potter, *General Electric Company*, and A. F. Sheldon, *Kennecott Wire & Cable Co.* Everett Morss of *Simplex Wire & Cable Co.* was named treasurer.

* * *

L. W. ALEXANDER has been appointed manager of the Marketing Services Division in the *General Electric Company's* Electronics Department.

In his new position, Mr. Alexander who was formerly assistant manager of the Receiver Division, will have responsibility for market research activities of the department, will advise its product divisions on distribution, production, and inventory control, and will represent the manager of marketing in coordinating programs for product planning and service.

Mr. Alexander joined *General Electric* in 1933 and has worked at Schenectady, Bridgeport, Owensboro, and Syracuse.

—30—

"We prefer Rauland Tubes for decidedly Selfish Reasons"...

says Phil Kudler, *President, The Universal Radio Supply Company, Los Angeles, California*

"We, at Universal Radio Supply, prefer the Rauland TV Picture Tube line over all others and for decidedly selfish reasons. Not only are Rauland Picture Tubes tops in quality performance but by reason of this advantage, they are tops in sales as well and so we make more profit. Those kit builders who have used Rauland Picture Tubes have adopted them as their standard and these facts, coupled with being able to replace the tube in any set with a Rauland tube, means there is no sales resistance when we offer our customer a Rauland Picture Tube. Rauland's new Luxide Screen Tubes with the black face are 'out of this world'—no glare whatever and soothing to the eyes—no filter necessary."

Two Reasons for Rauland's Leadership

Rauland Aluminized Tubes

The preferred replacement tube that gives users a better picture than when their sets were new. Gives up to 80% brighter picture than standard tubes, with better contrast and definition. Replaces any magnetic tube—needs no ion trap magnet—eliminates risk of damage resulting from faulty magnet adjustment. Boosts filter sales too—because the extra brightness carries a clear, sharp picture through even a heavy filter.

Rauland Luxide Screen Tubes

The sensational new "Black" Tube that gives notable improvement in contrast, clarity and picture detail. The special light-absorbing glass of the Luxide screen sharply reduces reflection of ambient light from the phosphors of the screen—greatly reduces halation—two reasons why pictures "wash out." All-glass 12LP4A and metal cone 16AP4A are available for replacement of corresponding standard tubes.

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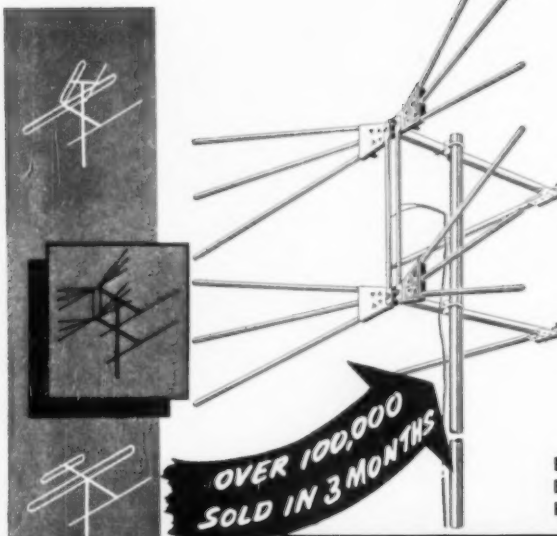
from the
OUTSTANDING LINE



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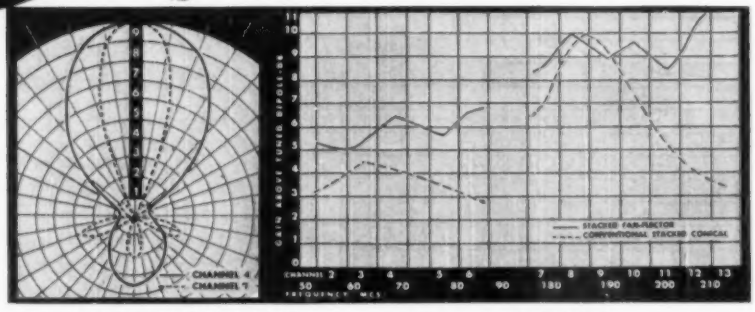
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CHANNEL 7
GAIN ABOVE TUNED DIPOLE-DB
STACKED FAN-FLECTOR
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CHANNEL 2 3 4 5 6 7 8 9 10 11 12 13
50 60 70 80 90 180 190 200 210
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Low band front-to-back ratios between 3 and 4 to 1. Lobe width decreases on high band for ghost-free reception. Vee-Beam engineering minimizes side lobes.

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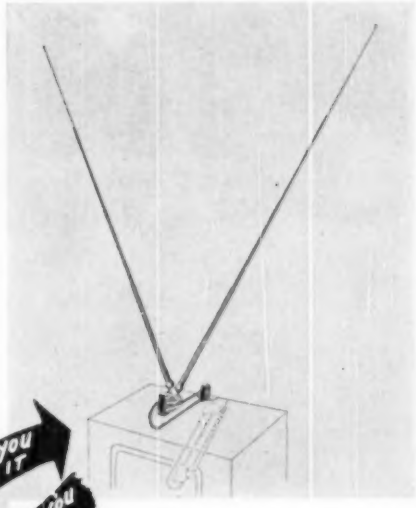
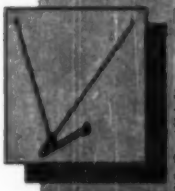
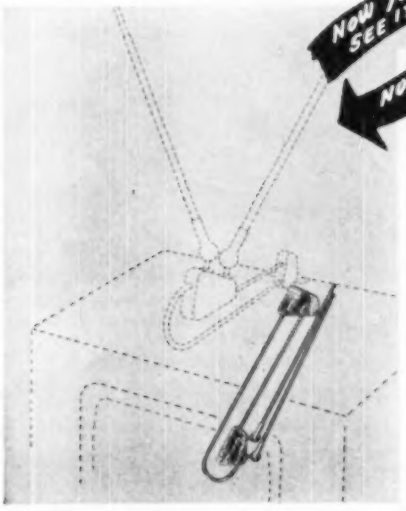
with

THE PERFORMANCE OF AN OUT-DOOR ANTENNA







Channel Master's exclusive Multiflex Action* enables this antenna to be hidden away behind the set when not in use. The elements can be arranged to form a horizontal Vee for any channel in any direction thus increasing the gain.

The hand rubbed hardwood surfaces, nickel plated metal components and smart design makes the Hideaway the most attractive indoor antenna on the market today.

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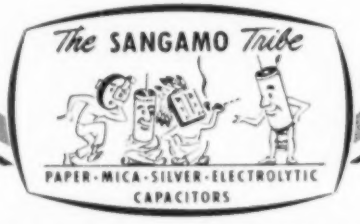

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MIDWEST RADIOS

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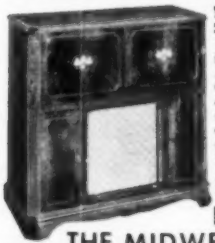
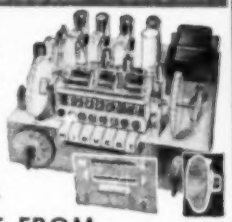


Powerful new 1950 Series 16 and Series 12 AM-FM Radio in complete chassis. Also beautiful new Console models including the magnificent Symphony Grand Radio-Phonograph with latest FM circuit and new 3-Speed Automatic Record Player.



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World Leader in Radio—First in Television

One of American Airlines' postwar fleet of DC-6's.

Aircraft RADIO

By
JAMES HOLAHAN*

A brief review of the field of aircraft radio, covering the nature of the work, the necessary qualifications for entering this field, and the available opportunities. The various types of radio equipment found in modern commercial planes are also discussed.

IN THE few brief years that comprise the history of aviation the expansion of air travel has been tremendous. The blockade of Berlin has proven to the world that life in a modern metropolis can, in an emergency, be sustained through the medium of air transport, in spite of the hazards of weather.

Throughout the United States hundreds of airfields, built by the military for training, are now serving in a commercial capacity as municipal airports. Few populated areas in the country are farther than a short drive from a local landing field. Foreign travel, too, has expanded. Giant wings and powerful engines are shrinking distances, formerly measured in weeks, into hours.

With this expansion of air travel new opportunities are opening up for the radio technician and electronic specialist.

Practically every aircraft in use today, both privately and commercially, carries some form of radio equipment ranging from a single receiver to complete racks of electronic gear.

Modern day flying has placed radio in the "essential" class. Improperly functioning radios are not only useless but hazardous because such great dependence is placed upon them.

This was pointed out as far back as 1929 in an article by an unnamed manager of the National Air Transport Company, when he wrote:

"There is no question as to the assistance that radio can give the air transport pilot. The problem is to insure against failure of the system. A catastrophe may easily be caused if the pilot relies on radio and it fails him for one cause or another. It would be far better if he had no radio at all."

These were the days when flying was in its infancy and many airmen used radio with caution and distrust. Today our entire system of instrument flying is built around radio. Complete radio failure in an airplane could result in disaster not only to the occupants of the affected aircraft but to other aircraft in the vicinity.

The use of radio in aircraft has transformed the airplane from a contraption reserved for daredevils to an instrument of commercial utility. It permits the pilot to fly through the worst weather without reference to the ground. It gives him a course to follow and enables him to keep in contact with ground stations and other aircraft.

Aircraft radio may be divided into two categories, communications and navigation. The radio gear carried on any aircraft is used for one or both of these purposes.

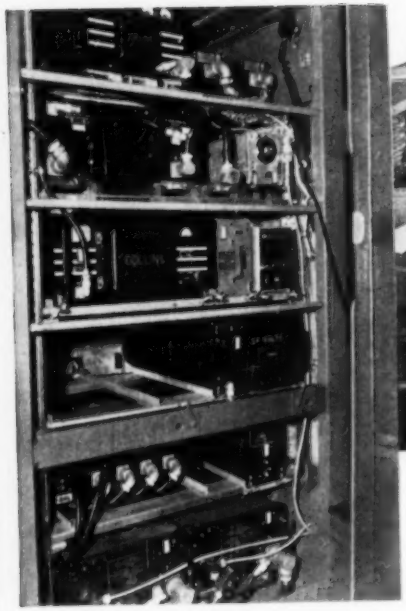
The communications category includes voice transmission and reception of pertinent messages, such as takeoff and landing instructions, flight plans, weather information, emergency calls, etc. On long trips away from ground stations, such as on transoceanic flights, c.w. is used.

The aircraft receives these voice and c.w. messages on the aircraft band (200-400 kc.) or on v.h.f. (100-150 mc. voice only) and transmits on a variety of medium high frequencies between 3 and 9 mc. with 3105 kc. and 6210 kc. being most frequently used in the United States. Communications from air to ground are also transmitted on any of the allotted channels between 100 and 150 mc.

Air navigation by radio requires more of a discussion. An extensive system of radio aids to navigation, which form the civil airways of the United States, is maintained by the Civil Aeronautics Authority, an agency of the Department of Commerce. The principal component of this system is the radio range station.

A radio range station consists of a transmitter emitting a carrier on an assigned frequency in the aircraft band. It has two independent r.f. channels differing in frequency by 1020 cycles, controlled by matched crystal oscil-

* The author is a radioman who became a pilot in the USAAF during the war. At the end of the war he was placed in charge of radio and radar maintenance at Rapid City Army Air Base. Since separation from service he has been in the aircraft radio field and is employed by Air Associates Inc.



A few of the radio operators employed by Trans World Air Lines. On these men fall the responsibility of transmitting important weather and flying data which keeps the planes aloft and safe during bad weather and good, clear skies and overcasts.

The radio installation in the "Convair." This 300 m.p.h. 40-passenger plane has a built in loading ramp, a cruising range of 800 miles, and an air-conditioned cabin.

The v.h.f. transmitting and receiving equipment installed in a Beech Bonanza baggage compartment.

lators. The antenna system is comprised of two crossed Adcock antennas that are 90 degrees in space with respect to each other, together with a center vertical antenna. The central tower is constantly fed by the output of one r.f. channel while the output of the other is switched from one Adcock antenna to the other. First the code letter "A" is fed to one Adcock then an "N" is fed to the other. A receiver monitoring these signals will pick up the 1020 cycle beat note which corresponds to the difference between the r.f. channels. A steady tone is heard whenever the energy from the two antenna systems is received with equal intensity. This is called the "on course" or beam. Each range station produces four beams, the direction of which is controlled by the directional antenna systems. These beams give the pilot a definite course to follow toward or away from the station. In the sectors between the courses either an "A" or "N" is received depending upon what quadrant the plane receiving the signal may be in.

Actually the civil airways are aerial routes whose courses are determined by these beams. While flying on the airways the pilot is aware of his position with respect to the range station, which he can locate on his map, from the type and intensity of the received signal. The point directly over the range station is identified by the lack of signal because the vertical antenna system used will radiate negligible energy directly upward. This "no signal" area widens with height and for that reason is called the "cone of silence." On most ranges the cone is further identified by a "Z" marker, operating on a frequency of 75 mc., which constantly keys the letter "Z". A special receiver is necessary to pick up this signal.

An important piece of equipment for radio navigation is the loop antenna.

We all know the directional qualities of a loop. For instance, a portable radio with a loop antenna will receive the maximum signal when the plane of the loop is in line with the station and minimum signal when the plane of the loop is at right angles to the station.

This same principle is used in navigation. In its simplest form, the loop is used with a receiver as an extra antenna which may be switched into the circuit for direction finding.

More elaborate receivers employ amplifiers and balancing networks which greatly increase the loop's sensitivity.

The loop is the heart of the radio compass or, as it is also called, the automatic direction finder. The operation of an ADF is simple—just tune in the desired station, identify it, flip a switch and a needle, mounted on a 360 degree azimuth scale, points to the angular direction of the station relative to the aircraft.

Formerly the radio compass, because of its weight, was confined to large aircraft only. Now a manufacturer has come out with an ADF weighing 24 lbs. including the power supply.

About the latest thing in radio navigation is the omnidirectional range which will soon be in operation all over the country. These ranges operate in the v.h.f. spectrum between 90 and 110 mc. In contrast to the low frequency ranges which present four beams or pathways to the station, the omnirange allows the aircraft to come in "on the beam" in any direction. The aircraft having this equipment installed will have a "To-From" indicator which tells the pilot whether he is going toward or away from the station he is working. On the low frequency ranges the

pilot determines this from the build or fading of signal strength which can often be difficult in times of poor reception due to precipitation static and the like.

For navigating great distances by radio, such as in transoceanic flying, a system called "loran" is used. The name is a coined word derived from the words LOng RAnge Navigation. Developed during the war, this system is composed of a receiver operating on a band just above the broadcast frequencies. There is no audio. Pips appearing on the face of the cathode-ray tube furnish visual information, which when applied to special loran charts gives very accurate fixes. The only installation required in the aircraft is the loran receiver.

Ground installations consist of several pairs of transmitting stations operating on the same frequency. In each pair one is termed the "master" the other the "slave" station. The system is based upon the microsecond interval between the reception of the signals emitted by the master and the slave.

A navigator, specially trained in the loran method of navigation, is required to operate this system. It is possible to obtain accurate fixes from stations up to 1500 miles distant by means of loran.

The instrument landing system may also be included in the navigation category. Two receivers and an instrument panel indicator comprise the main components of the ILS equipment as it is installed in the aircraft.

One receiver, the localizer, operates on any of six crystal-controlled frequencies located between 108 mc. and 110 mc. This receiver tells the pilot, through movements of a vertical needle of a specially designed microammeter, whether he is to the right or left of the runway. Actually the needle is differentiating between an area of 150 cycle modulation and 90 cycle modulation.

The path of descent can be seen in the movement of a horizontal needle of another microammeter utilizing the same meter face as the vertical needle. A glide path receiver controls the movement of the horizontal needle. It operates on three crystal-controlled channels between 332 mc. and 335 mc. The glide path signal when modulated by 150 cycles will indicate position above the correct path while 90 cycle modulation is used to show position below the correct path.

Also used for blind landings is the much publicized GCA-ground controlled approach. All the equipment that is needed in the aircraft in order to use this system is voice communication between the pilot and ground. The path of the aircraft is accurately plotted and the pilot is literally talked into a landing by ground operators.

Non-directional radio beacons and marker beacons are two more of the facilities offered by the Federal airways system. The former is simply a station transmitting a continuous carrier in the aircraft band interrupted by regular station identifications. It is used only with direction finders as a homing aid.

Marker beacons are vertically directed signals on 75 mc. These are located along the "on course" of low frequency radio ranges. They enable the pilot to definitely establish his position while flying the ranges.

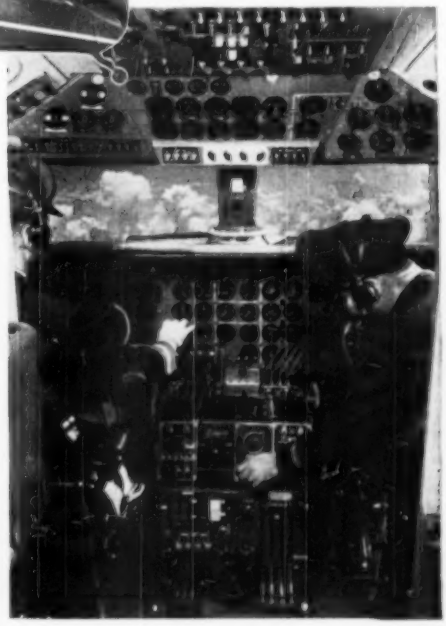
Thus it may be seen that the present day aircraft is well equipped with radio gear. In flying, radio is essential. Just as essential is the personnel which maintains this equipment.

Commercial operators (airlines, flight schools, charter companies, etc.) and most private owners who engage in regular and frequent flights away from their home airport have their radios checked periodically.

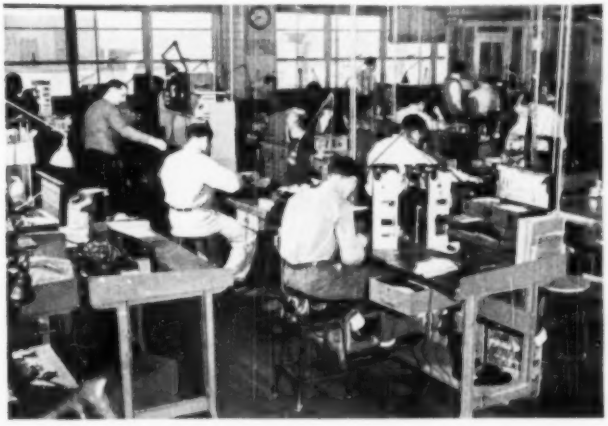
Scheduled airlines probably have as complete a radio maintenance system as can be found in the aviation industry. Here all radio equipment is given periodic checks

A 4-place Stinson, a private aircraft, showing rotatable loop antenna.

The instrument panel of the DC-6. Much of the responsibility for the safe operation of such sky giants rests with radio equipment.



An over-all view of American Airlines' radio overhaul shop. As mentioned in the article, the large commercial outfits stress preventive maintenance and subject all radio equipment to periodic and thorough checks.



according to the number of hours which the ship has flown. There are checks approximately every 25 hours. Each succeeding check involves more operations until, at the end of a set period of time, say 2000 hours, all the radio gear is removed for overhaul and bench checks.

Aviation companies have found that it doesn't pay to wait until a unit breaks down before servicing it—preventive maintenance is the watchword. Those used to servicing home sets would find aircraft radio quite different in this respect—less than half the time is spent repairing defective units; more time is consumed looking for troubles before they cause the delay of a flight.

The more technical aspects of an aircraft radioman's job involve making new installations and modifying certain types (especially surplus) radio equipment, either to improve performance or to conform with government regulations. In large companies very little of the installation or conversion work is left to the initiative of the technician. In small outfits the success of the installations and conversions is largely dependent upon the skill of the technician.

The qualifications necessary for an aircraft radio technician can be summed up in five basic requirements:

1. *Technical knowledge.* He must possess a high degree of widely diversified theoretical and practical knowledge of radio.

2. *Mechanical ability.* He must be able to work well with tools and be fairly skillful in designing and building things of a mechanical nature.

3. *Familiarity with aircraft.* Since most of the equipment is installed in aircraft, familiarity with the location of the power sources, switches, controls, etc., are of vital importance.

4. *Physical fitness.* This work involves a good deal of climbing in and out of tight places, much walking, and lugging of heavy equipment.

5. *FCC license.* A 2nd class phone is the minimum license requirement. If a man has the proper technical knowledge all the preparation needed to pass this exam is a study of the FCC regulations governing the holders of commercial licenses. However, a review of a "question and answer" book (sold at most technical book stores) for this exam, might prove helpful to those who might be rusty on theory.

Now, providing a man has the proper qualifications, the next step would be applying for a position. Let us consider the main sources of employment. There are five.

1. Scheduled airlines
2. Non-scheduled airlines
3. Maintenance and overhaul shops
4. Civil service
5. Own business

The scheduled airlines hire the bulk of the personnel, each major airline having in the neighborhood of 50 to 175 men over-all, doing radio work. The starting pay is fair—about $1.52 per hour with periodic increases governed by the length of service. The work is shift work. Working conditions and equipment are excellent. There is a strict union shop with its attendant seniority regulations.

Non-scheduled airlines pay on a par with the scheduled lines but do not offer the same security since the "non-scheds" have not as yet attained any form of inherent stability.

The working conditions are just fair while ofttimes the equipment is worse. Here more skill and versatility is required. Hours are frequently long and irregular. However, experience is plentiful and the opportunities of high gains that go along with new enterprise are ever present.

Maintenance and overhaul shops usually pay scheduled airline rates to the regular technicians but the rates of the leadmen and foremen are somewhat higher. Here the hours and working conditions depend upon many factors, such as the size and policy of the particular shop.

Civil service positions are sometimes available in the aircraft radio field as civilian technicians with the armed services and with the Civil Aeronautics Authority.

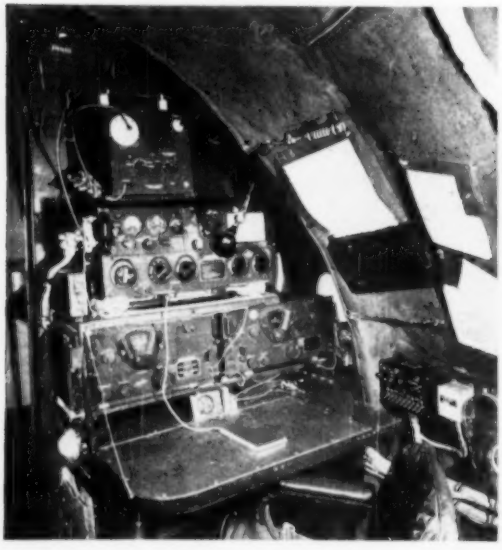
With the latter the work is for the most part installing and maintaining the ground stations of the radio aids to aerial navigation that span the entire country. Such positions for technicians pay between three and four thousand per year, depending upon the classification of the work. Announcements of examinations for these positions appear in the Civil Service periodicals.

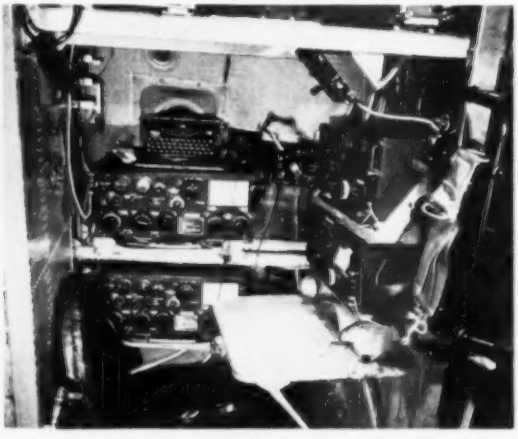
Operating one's own business will offer opportunity only to those experienced in aircraft radio as well as business techniques.

Not unlike similar ventures in the home sales-service field it offers advantages, such as being your own boss, on the one side and disadvantages, like a seven day-ninety hour week, on the other.

For the benefit of those considering an entry into this phase of electronics let me outline briefly the future of aviation radio.

(*Continued on page* 106)





(Below) The radio operator's station in a Douglas DC-4. Note the many different types of radio equipment used in the operation of this craft. (Left) The radio panel of the four-engined "Constellation." Because the "Connie" is used for long, over-ocean flights the radio equipment includes c.w. as well as phone equipment. Note the sending key in the right center of the photograph.

FREQUENCY MEASUREMENTS for Citizens Radio

By HAROLD McKAY
Electronic Consultant

Top and bottom views of the home-built test unit designed for adjusting the transmitter frequency of citizens band transceivers.

Complete construction details for a single-tube frequency test instrument covering 460-470 mc. FM broadcast stations are used as frequency standards.

THOSE who would experiment with radio equipment for use in the citizens radio band (460-470 mc.) will require certain test equipment in order to properly service and adjust their sets.

Most important of the test instruments which will be needed is a device for adjusting the transmitter frequency within the limits prescribed by the Federal Communications Commission.

Commercial frequency meters which cover this band range in price from $42 to several hundred dollars. These instruments provide a degree of accuracy which is not needed for citizens radio. Therefore, simple devices may be constructed which will serve the purposes and at a cost of $10 or less.

Crystal Oscillator

One such device is a simple oscillator, such as shown in Fig. 1. This unit employs a 5 mc. crystal which is available as a surplus item at nominal cost. While the basic circuit is of standard design, this application features a power supply without filtering equipment.

The pulsating direct current, which is applied to the plate of the oscillator portion of the tube, results in the creation of a large number of harmonics, and, in addition, provides an audible tone composed of power line harmonics which can readily be identified in a receiver.

Radio frequency harmonics in the 460-470 mc. region are accentuated by the use of an antenna connected to the plate of the oscillator. This antenna is one-quarter wavelength (161 mm.) long.

In use, the oscillator should be compared at its fundamental with station WWV, by listening to both on any receiver which will bring in the station on 5 megacycles. If the crystal deviates too much from WWV, a small trimmer condenser may be placed in parallel with the crystal to bring it to proper frequency.

Bear in mind that the 93rd harmonic of the crystal is being used at 465 mc., and any error in crystal calibration is multiplied accordingly.

FCC requirements for Class B citizens radio call for all operation (tolerance and communication band) to be within plus or minus 0.4% of 465 mc. This provides a bandwidth of 3.72 megacycles, which allows a great deal of leeway. Practically, if the crystal beats within the audio range with WWV it will be satisfactory without further adjustment.

To adjust a transmitter with the crystal oscillator, it is first necessary to make an approximate adjustment with a Lecher wire system, or a calibrated receiver.

This is necessary because the crystal oscillator will put out harmonics at 5 mc. points, out to 1500 mc. The signal from the oscillator will appear at 460, 465, and 470 mc. and it is necessary to identify the correct frequency.

A calibrated receiver will locate these points readily but if this is not available the transmitter must be tuned by the Lecher wire system, to a point near 465 mc.

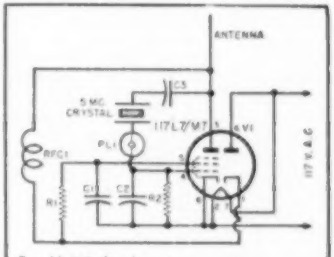
The transmitter is then tuned in on a receiver, on which the 465 mc. harmonic of the oscillator can be heard. The transmitter is then carefully adjusted to zero-beat with the oscillator.

Harmonics from the crystal can be heard at 465 mc. even on such insensitive receivers as the BC-645, if the receiving antenna is brought within an inch or so of the oscillator antenna.

It may be necessary to move the transmitter some distance away from the receiver while comparing its signal with that from the crystal in order to diminish the strength of the signal.

(Continued on page 102)

Fig. 1. Schematic diagram of crystal oscillator for 465 mc. frequency measurements.



R_1—25,000 ohm, 1/2 w. res.
R_2—100,000 ohm, 1/2 w. res.
C_1—.01 mfd., 400 v. cond.
C_2—100 mmfd. mica cond.
C_3—.001 mfd., 400 v. cond.
RFC_1—2.5 mh. r.f. choke
PL_1—2 v., 60 ma. pilot lamp (Mazda 48)
V_1—117L7/M7 GT tube
Crystal—5 mc. crystal
Antenna—¼ wavelength for frequency required

IS *Stratovision* THE ANSWER?

By KENNETH R. BOORD

Fourteen planes would provide adequate coverage for approximately 78% of the people in the U.S.A.

ALTHOUGH *Stratovision* experiments in the United States have been suspended temporarily, there are many TV authorities who believe it is the *only* answer to truly adequate "nationwide" video coverage—including the small towns and rural areas as well as the large metropolitan centers of the country. Five years ago (1945), the *Westinghouse Electric Corporation*, in cooperation with *The Glenn L. Martin Co.*, announced the intention of developing this system in the United States.

What is Stratovision?

It is airborne television—transmission relay from planes in motion at high altitudes. By raising the broadcasting antenna to greater heights, relatively large improvements in v.h.f. (very-high frequency) and u.h.f. (ultra-high frequency) transmission range may be obtained. "Radio" horizon distances, of course, are largely dependent upon atmospheric conditions. A transmitting antenna 30,000 feet above the earth's surface has a "line of sight" distance to the horizon of 211 miles, and this distance roughly represents the service area of such a v.h.f. or u.h.f. transmitting antenna. Assuming true spherical earth conditions, calculations indicate that television coverage over this large distance is attainable with powers equivalent to those used in present-day commercial television stations.

A transmitter operating at 600 megacycles, airborne 30,000 feet above the surface of the earth, with an effective radiated power of 25 kw. assumed, will achieve a field intensity of 2 millivolts per meter for a 30-foot high receiving antenna, out to 238 miles. This distance represents the coverage from an airborne station over the earth.

Minimum values of field intensity occur at several points closer to the transmitter and fall below the value of two mv/m. required for service. These minimums will not occur at the same distances for a different receiving antenna height. This makes it possible to increase the field intensity at any location by changing (either raising or lowering) the receiving antenna by a few feet. Energy at the receiving antenna arrives from the transmitting antenna over two paths—a *direct* path and a *reflected* path. Thus, the net energy at the receiving antenna is a vectorial addition of these two components. As the distance between transmitter and receiver is changed (or the antenna heights are changed), the changing vectorial relationship produces nulls and maximums. There are as many nulls between the transmitter and its horizon as the number of half-wavelengths that the receiving antenna is above ground. It is desirable to reduce the receiving antenna height as the receiver is moved closer to the transmitter, even to the point of laying it close to the ground when the location is near the transmitter.

Naturally, terrain factors influence the coverage obtained, and these factors have a greater attenuative effect in the u.h.f. television band than in the v.h.f. band.

Testing

The *Westinghouse* and *Glenn Martin* companies undertook two series of flight tests to study the propagation and plane motion effects. The first of these studies was made with a twin-engine PV-2 aircraft, capable of operation at 25,000 feet. (This ship was by no means of the type suitable for day-to-day broadcasting but was quite suitable for propagation measurements.)

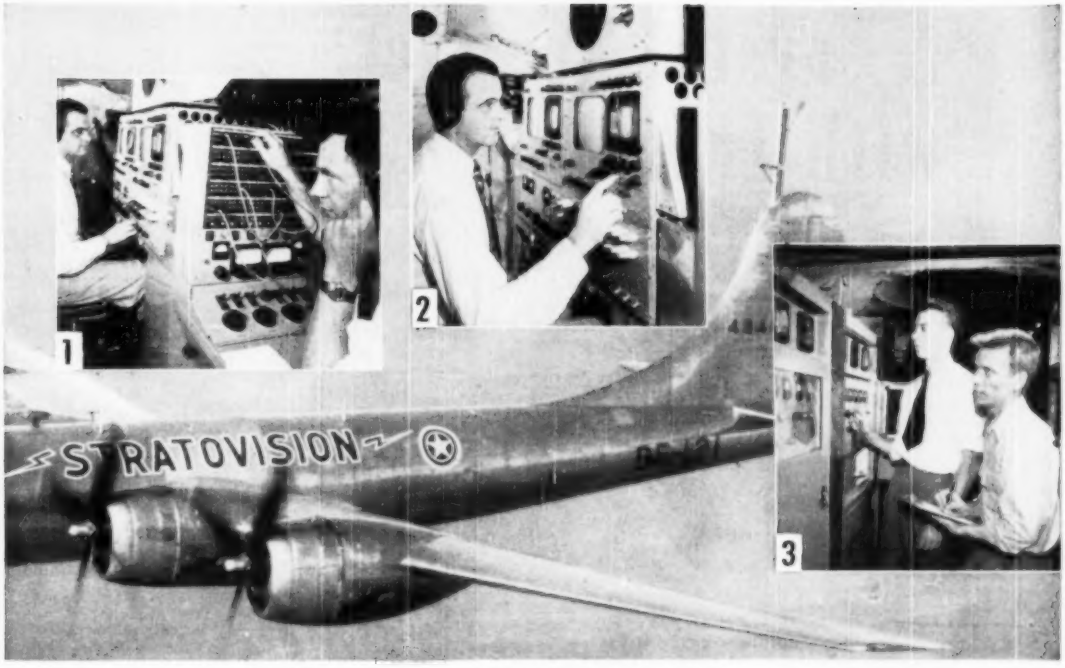
Two transmitters were installed in the unpressurized cabin of this ship. A 250-watt transmitter, operating on 107.5 mc., and a 5 kw. (peak of pulse) transmitter operating at 514 mc., were flown at various altitudes away from Baltimore (Maryland), and continuous recordings of field intensity were made at locations ranging from Norfolk (Virginia), to Pittsburgh (Pennsylvania), and Boston (Massachusetts).

During the one-year flight-test period using PV-2, measured field intensities were compared with calculated values and effects of motion of the plane upon the pulsed waveform of the 500 mc. transmitter were studied. No effects of the motion of the plane were found except for the expected variation of field intensity as the distance changed. Measured field intensities agreed with calculated values reasonably well when the receiving antenna site approached a true spherical earth condition. Departure below predicted values was noted when the receiving antenna was down behind a hill. In a comparison study of measured and calculated values when the receiving antenna was set up on a beach at Norfolk (Virginia)—the total path between transmitter and receiver being over the waters of Chesapeake Bay—it was noted that even with this ideal "spherical earth" location, the minimums were never as deep as calculated.

As a result of these tests, the two companies were encouraged to equip a more suitable plane for actual picture transmission in accordance with commercial television standards.

A complete set of modern TV transmission equipment was built and in-

The experimental Stratovision station (a modified B-29), flying at 25,000 feet over the Pittsburgh area, rebroadcast telecast picked up from the east coast television network over an estimated area 525 miles in diameter. Programs from the ground stations are picked up on the antenna projecting above the tail, and rebroadcast from the long, mast-like antenna extending down from the nose of the plane.



1 C. E. Nobles (shown at left), originator of the Stratovision system for airborne television and frequency modulation transmission, monitors the television signal received and transmitted from the Stratovision airplane. Ben Carroll (shown at right), Martin Stratovision project engineer, listens at the sound monitoring position.

2 C. E. Nobles at the twin video monitoring boards in the experimental Stratovision airplane. The boards are so arranged that each can be used separately to monitor the video signal coming to the plane or the signal being transmitted by the plane, or they may be used together so that the signal picked up by the plane appears on one screen while the plane's broadcasted video signal is monitored on the other. The TV picture is viewed on the large screen.

3 Angus A. Macdonald (left) and Larry Smith, Westinghouse engineers, record current and voltage readings of the 1000 watt transmitter used to rebroadcast frequency modulation sound signals from the airplane. This transmitter plus the TV transmitter and the other equipment aboard the plane generated so much heat in early flight tests that a refrigeration system, capable of air conditioning a seven room house, was installed promptly.

stalled in a B-29 "Super Fortress" with all military armament removed to make room for the TV equipment. This aircraft is a pressurized, four-engine, high-altitude airplane capable of operation at 30,000 feet.

Television equipment installed in this ship consisted of receivers capable of receiving standard commercial television stations or a special 547.5 mc. relay link from the *Westinghouse* studios in Baltimore (Maryland). Transmitting equipment capable of emitting 5 kw. of video and 1 kw. of sound on TV Channel 6 (82-88 mc.) and monitoring and control equipment were also installed. In addition, other transmitters operating on 250 mc. (with 200 watts c.w.), 750 mc. (with 200 watts c.w.), and 3300 mc. (with 50 kw. peak of pulse) were installed to carry out further propagation measurements.

Receiving circular dipoles were located on an eight-foot streamlined mast atop the vertical tail fin. These antennas were used to receive standard ground stations for rebroadcast. The vertical tail fin was chosen as a location for the receiving array because it was the spot most isolated from the transmitting array, thereby reducing the problems of receiving weak signals in close proximity with the 5 kw. video and the sound transmitters. This location plus the use of filters made it possible to receive any commercial channel except Channel 5, where the lower sideband components of the Channel 6 transmitter were relatively high.

In broadcasting position, the main transmitting antenna mast hung vertically downwards. This mast carried a two-element turnstile array for the Channel 6 video carrier, a single-element circular dipole sound antenna, and a 547.5 mc. relay link receiving array. The mast is 28 feet long and induced some 600 h.p. of additional drag to the plane in spite of its being streamlined. This array, of course, was retractable for take-offs and landings.

Power for all equipment was obtained from three 15 kva., 500-cycle alternators coupled directly to the plane's engines. The plane used a 70,000-BTU-per-hour air conditioning system in order to dissipate the heat from the operating compartment. Without air conditioning, the compartment temperatures reached 134 degrees Fahrenheit in spite of the fact that outside air temperatures were 25 degrees Fahrenheit.

This equipment was flown more or less regularly from June of 1948 to February of 1949. Usual flight procedure after take-off from Baltimore (Maryland) was to climb to operating altitude at Baltimore. During the hour required to climb, equipment was brought on the air and checked out. Upon reaching altitude, the plane was flown away from Baltimore while continuous propagation measurements and range measurements were being made. The programs of WMAR-TV of Baltimore usually were broadcast on Channel 6.

After each flight, many TV fans wrote in to describe results of the test at their particular location. These reports from the public were numerous; several hundred letters were received

(*Continued on page* 145)

A Crystal Receiver with Transistor Amplifier

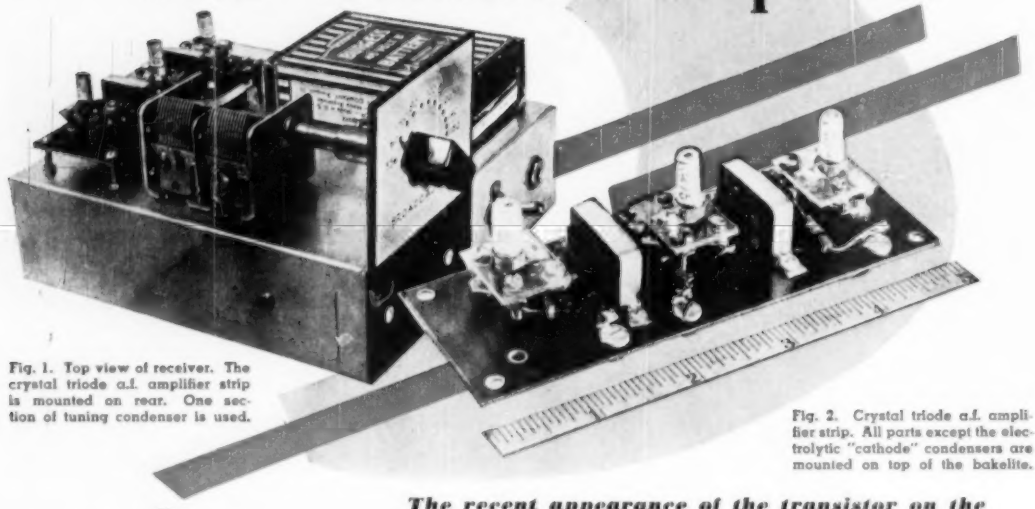


Fig. 1. Top view of receiver. The crystal triode a.f. amplifier strip is mounted on rear. One section of tuning condenser is used.

Fig. 2. Crystal triode a.f. amplifier strip. All parts except the electrolytic "cathode" condensers are mounted on top of the bakelite.

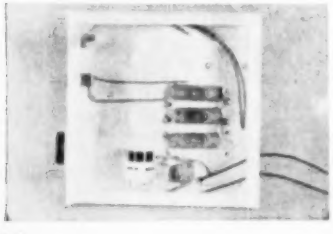
By
RUFUS P. TURNER, K6AI

The recent appearance of the transistor on the commercial market opens new fields to the radio experimenter. One of its uses is discussed here.

THE introduction of *Raytheon's* new CK-703 crystal triode opens up a new field of interest for the radio experimenter. Recommended for use at frequencies up to the video range, this commercial *transistor* can be used as a medium mu a.f. or r.f. amplifier, oscillator, or control "tube." Simple, small-sized, and lightweight electronic equipment may be built around crystal triodes. Enterprising radio men undoubtedly will find a host of applications for this device.

This article describes a simple crystal diode broadcast receiver with a crystal triode audio amplifier. Although this set will not operate a loudspeaker, it will give a walloping good signal in high-impedance headphones, provided it is connected to a good outside antenna *and* ground. A great deal of satisfaction may be derived from its operation, and some experience with crystal triodes gained as well.

Fig. 3. Under chassis view of the receiver showing components and simple wiring.



Before describing the receiver, however, we will explain briefly the characteristics and construction of the crystal triode.

Features of Transistor

The transistor is a germanium crystal device. It differs from the familiar crystal diode, of which the 1N34 is a well known example, chiefly in that the transistor has two catwhiskers instead of one. One whisker, called the *emitter*, acts in a manner comparable to the grid of a triode vacuum tube. The point of the second whisker, called the *collector*, touches the surface of the germanium crystal extremely close to the place of contact of the first whisker and acts like the plate of a triode tube. The crystal itself (called the *base* in crystal triode terminology) is comparable to the cathode of a tube. Unlike a tube, however, the emitter (grid) of the crystal triode is biased with a low *positive* voltage, while the collector (plate) receives a high *negative* voltage. Another important difference is that the crystal triode has a low-impedance input and a high-impedance output. The recommended circuit symbol for the transistor is shown in Fig. 5A.

The CK-703 (See Figs. 5B and 7) is a small-sized unit, being only 0.78 inch (maximum) long and 0.255 inch in diameter. The housing of the CK-703 is a cylindrical brass shell to which the crystal is connected internally. This shell serves as the base (cathode) terminal. The emitter and collector whiskers are connected to two nickel contact pins which extend through an insulating disc-plug in one end of the brass shell. Fig. 5B identifies these pins in bottom view. The CK-703 has an input (emitter) impedance of 500 ohms and output (collector) impedance of 10,000 ohms. It is rated at 2 milliwatts average power output with an average power gain of 16 db. The power rating is on the basis of a 50-microwatt signal applied to the emitter. Table 1 gives the important electrical characteristics of the CK-703.

From the impedance ratings, it is evident that a conventional amplifier circuit employing crystal triodes must provide for an impedance step-down between stages. This means that interstage transformers must have a step-down turns ratio.

Receiver Circuit

Fig. 4 is the complete schematic for the receiver. This circuit is entirely conventional except for the employment of a 3-stage crystal triode audio amplifier.

The input coupler, L_1-L_2, is a standard broadcast antenna coil of the type

used in midget receivers (*J. W. Miller* 20-A). This coil has been center tapped in order to match the impedance of the crystal detector more effectively and to improve selectivity. The center tap must be provided by the builder, since this coil normally is not supplied with one. Tuning is accomplished by means of a midget 365 $\mu\mu$fd. variable condenser, C_1.

The detector diode is the new *Sylvania* 1N54 high-efficiency unit. The cathode of this diode is connected directly to the high end of a 500 ohm load resistor, R_1, and to the emitter terminal of the first CK-703 socket.

In order to dispense with emitter batteries in the amplifier, the author has employed base or "cathode" resistors, R_3, R_6 and R_9, in each stage. Collector current flowing through each of these resistors develops a voltage drop which is applied as a small positive potential to the emitter terminals. The 500 ohm value is correct for R_3, R_6 and R_9. Reducing this resistance decreases power output and increases distortion. While there has been some criticism regarding this method of operation, it has given satisfactory operation in practice.

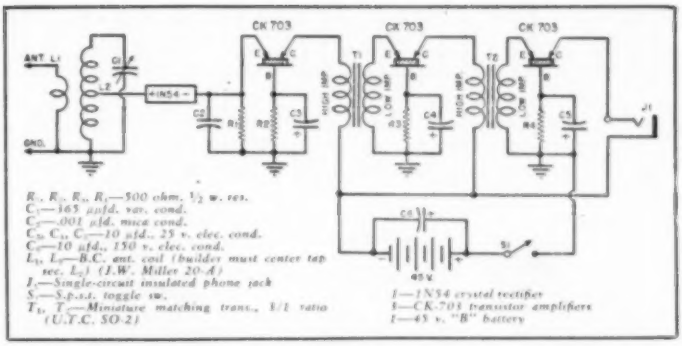
The interstage transformers, T_1 and T_2, employed by the author are *U.T.C.* sub-ouncers Type SO-2. These transformers are connected backward. That is, the normal secondary (high impedance) is connected to the collector output of one crystal triode, while the primary (low impedance) is connected to the emitter input of the following crystal triode. While these transformers were not designed specifically for this application, they have approximately the proper turns ratio for the required impedance transformation and are very small in size. To improve fidelity, an individual builder may prefer to shunt-connect the transformers to keep d.c. out of their windings.

The headphones are connected in series, through the output jack, with the collector of the last crystal triode and the negative battery terminal. Operation of a pair of 2000 ohm headphones has been satisfactory in this circuit.

In the event that crystal headphones are used it will be necessary to use a choke and condenser coupling arrangement to keep the d.c. out of the headphones.

A single 45 volt battery is employed for power and is bypassed by a 10 μfd., 150 volt electrolytic condenser, C_8. There is sufficient voltage drop across the high-impedance windings of the two transformers to reduce the collector-to-base d.c. voltage in each amplifier stage to about 37 volts.

It is absolutely imperative that proper polarities of the crystal diode and of the three crystal triodes be observed. For this reason, the cathode terminal of the diode has been labeled in Fig. 4, and so have the emitter (*E*), collector (*C*), and base (*B*) terminals of each crystal triode. The builder must be careful to ground the positive terminals of electrolytic condensers C_3, C_6, and C_9 and also to connect the positive battery terminal to ground. It will be easy to make a mistake in these connections, since radio technicians are well-schooled in the opposite procedure of connecting "B-minus" and the negative terminals of cathode bypass condensers to ground. The crystal triodes definitely will be burned out if the battery polarity is reversed.



R_1, R_3, R_6, R_9—500 ohm, ½ w. res.
C_1—365 $\mu\mu$fd. var. cond.
C_2—.001 μfd. mica cond.
C_3, C_6, C_9—10 μfd., 25 v. elec. cond.
C_8—10 μfd., 150 v. elec. cond.
L_1, L_2—B.C. ant. coil (builder must center tap sec. L_2) (*J.W. Miller* 20-A)
J—Single-circuit insulated phone jack
S—S.p.s.t. toggle sw.
T_1, T_2—Miniature matching trans., 3/1 ratio (*U.T.C.* SO-2)
1—1N54 crystal rectifier
3—CK-703 transistor amplifiers
1—45 v. "B" battery

Fig. 4. Complete circuit diagram and parts list for the crystal transistor receiver.

TYPICAL OPERATION	
Emitter Voltage	0.2 v.
Emitter Current	0.75 ma.
Collector Voltage	—30 v.
Collector Current	2.0 ma.
Transconductance	5000 micromhos
Emitter Impedance	500 ohms
Collector Impedance	10,000 ohms
Average Power Output	2 milliwatts
Average Power Gain	16 db.
MAXIMUM RATINGS	
Collector Voltage	—70 v.
Collector Current	4.0 ma.
Collector Dissipation	200 milliwatts
Emitter Current	10 ma.

Table 1. Electrical characteristics of CK-703.

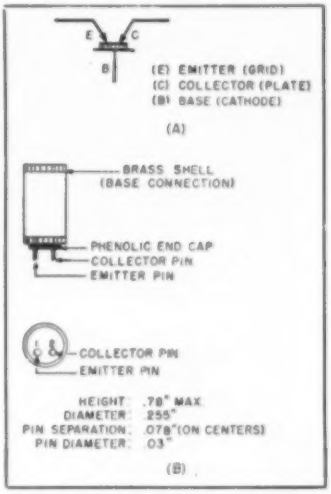


Fig. 5. (A) Circuit symbols for the transistor. (B) Details of CK-703 crystal triode.

Construction

At this writing, no sockets have been manufactured for the CK-703. For this reason, the author made his own. Fig. 8 gives constructional details of the home-made socket, and Fig. 6 shows two completed sockets. Undoubtedly, the sockets could have been made smaller in size. The reader who is mechanically proficient may prefer to follow an entirely different design.

The basic requirement in the transistor socket is that good contact be made separately to the outer metal shell of the CK-703 and to each of the base pins. Whatever type of contact is used, it must grip the shell and pins firmly but without bending, twisting, or denting. Soldering to the CK-703 is not advised.

(*Continued on page* 153)

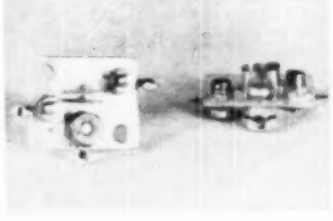


Fig. 6. Home-made wafer-type CK-703 sockets. Bottom view shows transistor plugged into socket with the two base pins in contact with the wire springs. Brass shell for gripping the CK-703 case is shown at right.

Fig. 7. Three new CK-703 crystal triodes. The contact pins are the collector (plate) and emitter (grid) terminals. Brass shell is connected to the crystal and is the base (cathode) terminal. Triode is .78" by .255".

The BEGINNING AMATEUR

Part 12. Covering the radio ham and how he can prepare for a career in radio and electronics industry. This article concludes the series.

Radio engineers at work in the electronics laboratory of the General Electric Co., Syracuse. Elaborate equipment setups of this kind are common.

By ROBERT HERTZBERG, W2DJJ

MANY young men take up ham radio as a hobby and become so engrossed in it that they decide to make electronics their life work. This is a perfectly natural development and should be encouraged by parents, because radio in its multiple ramifications offers almost unlimited opportunities to serious, diligent workers.

Former and present hams are scattered throughout every level of the radio game: engineering, manufacturing, selling, advertising, broadcasting, and servicing. The history of the art is full of the names of hams who made good in a big way. Edwin H. Armstrong, whose invention of the regenerative, superregenerative, and superheterodyne circuits, and of FM broadcasting easily rates him the title "Radio's No. 1 Wizard," still talks proudly of his pioneer amateur station of 1906 in which he started his famous researches. Allen B. DuMont, whose name is synonymous with television, was an active ham two decades ago while he was an engineer with various radio firms. The huge organization which he now heads is the direct outgrowth of a modest laboratory-shop he had in the basement of his home in Upper Montclair, N. J., in 1931. Sound broadcasting as we know it today had its real beginning in 1920 with W8XK, a ham station in the backyard garage of Frank Conrad in Wilkinsburg, Pa. This modest rig became KDKA, and Dr. Conrad became assistant chief engineer of *Westinghouse*, the recipient of numerous awards for his accomplishments. The great Marconi himself, the man who literally electrified the world at the turn of the century with his demonstrations of communication through space, was scarcely 20 years old when he undertook his initial "wireless" experiments with odds and ends of equipment, just as many an aspiring ham does today!

Amateur experience is valuable to the embryo engineer because it gives him a feeling for the *practical* side of a science that too often wanders into the realm of abstract mathematics. Since a ham is by nature an experimenter, a ham-turned-engineer is likely to use his soldering iron *as well as* his slide-rule, with very beneficial results.

Because electronics plays such a large part in our national military establishment, the Army, the Navy, and Air Forces practically compete with each other to get hams to join up. All the services offer extensive courses of training to further the technical competence of the men and women who are responsible for the operation of billions of dollars worth of radio-radar equipment. The attractions and advantages of service careers appeal to many young men. As with industry, the services are loaded with hams in all ranks, from privates and seamen to generals and admirals. Lieut. General Curtis LeMay, former commander of the U.S. Air Force in Germany and present commander of the Strategic Air Command, is an ardent ham of long standing and while in Germany was on the air almost nightly with a D4 call. At the big schools for electronic technicians run by the military departments there are so many amateurs, among both the instructors and the students, that the general atmosphere of these places almost resembles that of a hamfest. At Fort Monmouth, N. J. the home of the Army's Signal School, there are four separate ham clubs, and barracks and other quarters are festooned with antennas. There is some feeling among the officers there that a CQ whistled over the p.a. system would get quicker results than the bugle call "Assembly."

How does a ham become something more than a ham? For a lad whose objective is engineering, the course is very clear: A sojourn of four years at a recognized college offering the degree of electrical engineering, or, more commonly, bachelor of science in electrical engineering (B.S., E.E.). Some schools give all applicants an entrance examination, regardless of their previous training; some admit high school graduates on the strength of their diplomas alone. A man studies basic electrical engineer-

ing and majors, or specializes, in electronics or communications toward the end of the course. After graduation, he can take further specialized courses at universities that have advanced facilities, and he can obtain additional degrees, such as master of science or doctor of science. If his money, his eyesight, and his girl friend don't disappear in the meantime, he can work up to the degree of doctor of philosophy and earn the right to be called "Doctor Whoozis" in academic and technical circles.

No matter how much practical and theoretical instruction and experience a radio man has had, he is not considered an "engineer" by the great majority of radio-electronics companies unless he can show a B.S.E.E., as a minimum. An engineer, by commonly accepted standards, is a man who can undertake original design work on projected equipment, or do a major revamping job on existing equipment; he can also do research work on circuits, tubes, materials, etc. Although degrees mean only that the holder has boned his way through college and are no indication of native intelligence, ability to get along with others, or willingness to work, the fact remains that they are the basis for selection of prospective employees by many employment managers.

A man who cannot show a degree from a recognized institution of learning, but who obviously knows a great deal about radio, is almost automatically classified as a "technician." This is a catch-all word meaning little because it is such broad term, but it does serve to separate the college-trained men from all others. Many "technicians" are employed in responsible jobs in large factories, laboratories, and telecommunications installations, but on the pay and recognition levels they rate below engineers. A highly competent "technician" can be a self-taught man, virtually without formal schooling. Starting as a ham at the age of 15 or 16, assiduously studying the excellent "amateur handbooks" available for a few dollars, and gathering practical experience with tools, meters, receivers, transmitters, etc., an intelligent lad can really learn a lot before he reaches voting age. He probably knows much more about some phases of radio than does another youngster who studied electronics through this time, but his deficiencies will show up very quickly in a

WHAT LEADERS IN THE RADIO FIELD THINK ABOUT HAM RADIO

RADIO & TELEVISION NEWS *asked a few prominent figures in the radio field for their opinion of ham radio as a background for a career in electronics. Here are their exact replies:*

"AMATEUR radio has been a valuable adjunct in helping me to keep abreast of the advances that have characterized radio from the time Marconi first spanned the Atlantic with wireless telegraph signals.

"In my particular case, amateur radio has paid double dividends. Its development in my early days as a ham encouraged me to study in order to apply new ideas to my amateur station. And, by continuing to study, I was able to be informed on the fast pace of the art. The knowledge gained has been of great assistance to me in my Government service.

"I am glad that through the years I have made it a point to find time to continue my amateur activity. This has kept me posted on the practical use of equipment and techniques which, I feel, has made me better qualified for administrative responsibilities."

George E. Sterling, *W3DF, Federal Communications Commissioner*

"HAM radio is probably the most useful hobby for a young man who plans to make a career in the electronics industry. Many of our leading engineers got their introduction to electronics through their experience as hams.

"The construction, maintenance, and operation of a ham rig gives a man valuable experience in troubleshooting, gives him a feel for electronic circuitry, and it gives him confidence, which means a definite edge over fellows without this experience.

"Many men who are classed as engineering assistants or lab technicians in our development labs find that day-to-day work gives them the same challenge, the same kind of effort, and the same pride of accomplishment that they used to get from tinkering with their ham rigs.

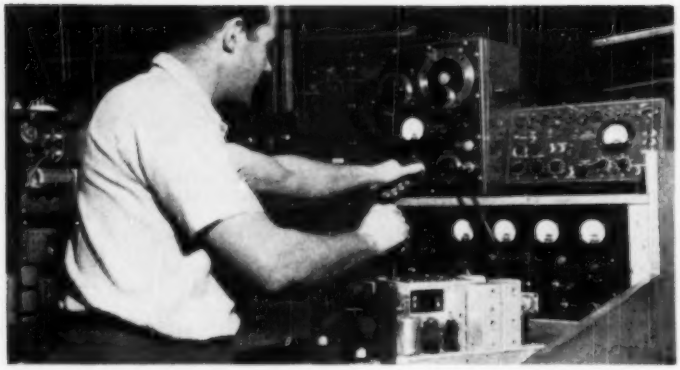
"Some of our engineers whose administrative responsibilities keep them at a desk find particular satisfaction in poking a hot soldering iron into their rigs at home.

"A vital part in the production of thousands of television sets is the troubleshooting of those which fail to pass regulation tests at the end of the assembly lines. Ham training is excellent background for these trouble-shooters."

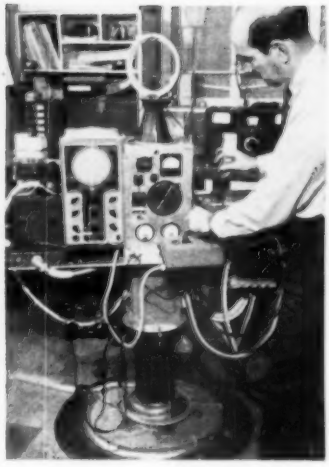
Dr. L. R. Fink, *mgr., Electronics Lab., General Electric Co., Syracuse, N. Y.*

"AMATEUR radio is, in my opinion, an excellent foundation for the young man who intends to follow one of the numerous branches of electronics as a career. Certainly the knowledge of election tubes, circuits, and measuring instruments, which he acquires while pursuing his hobby, should provide a good background for his later studies in college or vocational school. Rosters of radio firms almost invariably reveal one or more engineers, designers, or sales representatives whose first interest in electronics was acquired through the assembly and operation of a ham station."

Dr. E. W. Engstrom, *vice-president, in charge of research, RCA Labs., Princeton, N. J.*



↑ Service technician at work in the radio maintenance shop of American Airlines, located at LaGuardia Field, N. Y. He is shown aligning a high-frequency aircraft receiver with the aid of a signal generator.



Another shot of the radio maintenance shop of the American Airlines at LaGuardia Field. This technician, using highly accurate test equipment, is checking the calibration of a direction finder before installation. →

real test. For example, the "technician," with his bench-acquired "know how," is able to assemble and repair complicated equipment, such as a radar set, with ease and confidence. However, he's lost if the device starts to give false readings, because he doesn't know ordinary geometry, much less solid trigonometry, and radar is all a matter of angles in space. Here is where the "engineer" steps in and earns his salary. He solves the problem in a few minutes because he had solid trig and a dozen other forms of difficult math drummed into his head all during his college course. It might be said that mathematics is the dividing line between the true engineer and the technician.

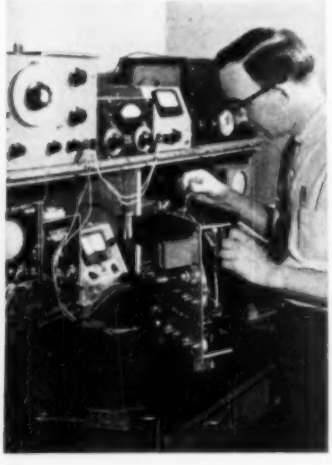
Some radio executives think that *too* much emphasis is placed on math in some schools, at the expense of practical training in the lab or field. This tendency is probably the result of our wartime (and even current) need for "brainy" guys who can use higher forms of math to solve the fantastically complex questions that arise in connection with guided missiles, nuclear physics, radar and telemetering, supersonics as applied to aircraft, etc. Many capable radio engineers who finished their schooling between ten and twenty years ago are quietly taking refresher courses at night; they find that the young squirts they hire fresh from college as their assistants know more theory and math than they do!

Suppose you can't afford to go to college, or feel that you are too old to start. Is there still a career for you in radio? Most definitely, *Yes*. There are excellent resident radio schools in several parts of the country where you can get concentrated, relatively short-term instruction in one or several phases of radio. Upon completion of the course, you are fully qualified to work as a service technician, factory production man, or radio station attendant. Don't for a moment think that you are an "engineer," because you're not. But don't let that bother you. For many of the jobs in radio, technicians are actually preferred to engineers.

If you can't get away from home to attend an out-of-town school, you can do very well or even better with correspondence courses. Thousands of successful, independent service technicians throughout the country can testify to the value of mail-order training. The lessons are carefully organized into small units, and you can do them as slowly or as quickly as your ability to assimilate them permits. And it's not merely "book learning"; with most of the courses you now get actual equipment that you assemble and operate yourself. With one television course there is provided a complete kit for an *RCA* 630TS receiver.

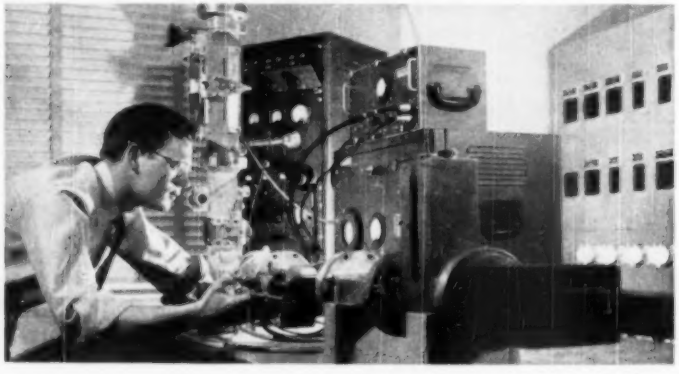
One very important feature of the correspondence training is financial: You can pay for most of the avail-

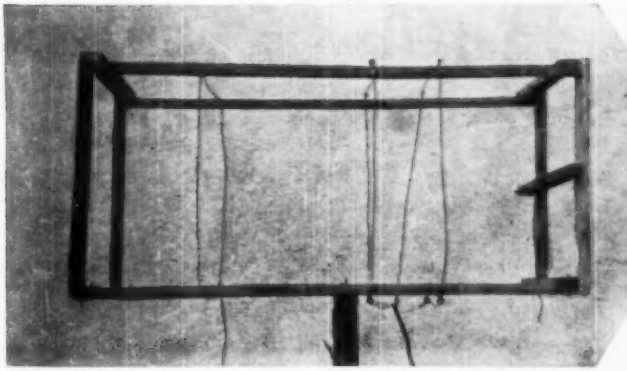
(*Continued on page* 131)



← Troubleshooting in an experimental circuit setup with a bench full of laboratory equipment is an everyday lab for a trained engineer. This is the electronics lab of the General Electric Company in Syracuse.

↓ A typical assignment for a graduate engineer, checking the performance of an experimental piece of high-frequency "plumbing." Another view of the electronics lab of the General Electric Co., Syracuse, N. Y.





A Two-Meter QUAD

The antenna is built on a simple wooden frame. A pipe mast is used for support and permits rotation.

By G. P. OBERTO

A three-element, high-frequency version of the quad antenna, giving a unidirectional pattern.

MANY hams and experimenters have been searching for an antenna that will give outstanding results on two meters and still fit into the family budget.

The type of quad to be described has a lower angle of radiation than that of the original cubical quad, because it is mounted horizontally instead of in accordance with the diamond mounting system used with the original quad. Height is not too important in using this type of antenna. Getting the array above trees and surrounding objects is all that is necessary for DX work on two meters.

Front-to-back ratio is very good. With a field-strength meter you will obtain readings only within 30°, standing 50 feet away from the front of the quad. Impedance is approximately 150 ohms, with one director loop and one reflector. The results obtained with this quad seem better on horizontal polarization than on vertical polarization.

Making a frame, 18 by 36 inches in size, is the first step, using 1" by 1" wooden strips. Take care to make this as light as possible, yet sturdy enough to withstand bad weather. For good, secure construction, slot the ends of each strip and use small bolts.

The radiator is made by winding two turns of No. 12 wire around the center of the frame with one-inch standoffs at each corner to give the wire a 19-inch length for each side. Space the turns five inches apart; no matching stub is required at this point. The 150 ohm feedline is connected to the ends of the loop.

Construct the director by making one turn of No. 12 wire, spaced 15 inches from the center of the two-turn loop, wound on the inside of the frame with insulators mounted one inch above each corner, leaving a 17-inch length of wire for each side. A 9- to 10-inch matching stub is fastened to the end of the one-turn loop. Proper matching can be determined by varying the length of the stub. A shorting bar will save a lot of time. However, a piece of 150 ohm twin-lead can be used by experimenting with different lengths.

The reflector is formed from two sections of No. 12 wire, 10¼ inches long for each section, mounted on a 22-inch board; the first two insulators are mounted one inch apart from the center of the board, and the last two are mounted 10¼ inches apart from the inside insulators. The board is fastened on the inside, 10 inches from the center of the two-turn loop. A 9- to 10-inch matching stub is also required at this point.

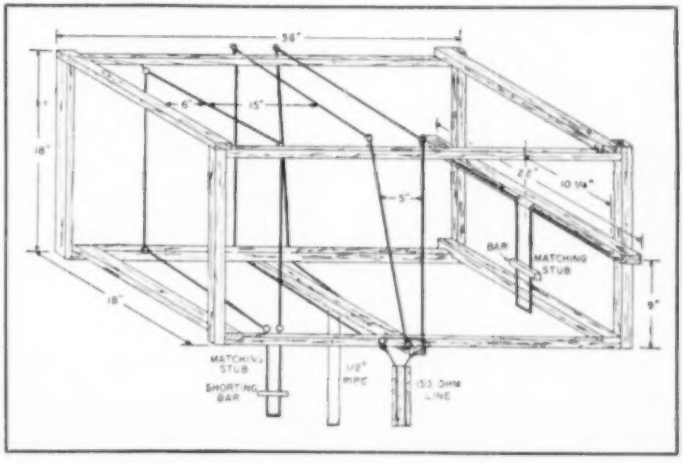
Although it was not tried, it is probable that the reflector could be a duplicate of the director if the reflector were wound on the outside of the framework to give the necessary added length.

The radiation pattern of an antenna of this type is horizontal, and parallel to the long dimension. The maximum radiation is off the director end.

Judging from experiments made with this antenna, it should perform as well or better than two five-element beams stacked.

-30-

Construction details and dimensions for the antenna. Rigid construction is necessary.



Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

Mac and Free Estimates

ONLY a coal dealer could have seen anything good about the bleak January day. Before daybreak a mixture of rain and sleet had begun to fall, and now at nine o'clock in the morning it was still hissing against the window of Mac's Radio Service Shop and slowly but surely coating everything outside with a sheath of ice.

Inside, though, things were proceeding quite normally. As usual, Barney was trying to beguile some information out of Mac, his boss.

"—and so," he was saying, "when I started to build this little phono-amplifier for Margie, I needed an output transformer. I found those three on the bench there in my parts collection, but they have no name on them. There's no way of knowing whether any of them will match a 6K6 to my four-ohm voice-coil. Unless you know what impedances an output transformer was designed to match, you might just as well not have the transformer."

"Well, now, I wouldn't say that!" Mac exclaimed in a startlingly-good imitation of Gildersleeve's Peavy.

Without further comment he clipped a couple of test leads to the secondary of one of the transformers and then inserted the other ends of the leads in the filament-pin holes of the four-prong socket of the tube tester. With the v.t.v.m. across these leads, he manipulated the filament voltage switch and the "line voltage adjust" control until he had exactly one volt across the voice-coil winding. Then he measured the voltage across the primary winding.

The procedure was repeated with the other two transformers, care being taken each time to see that exactly one volt was applied to the normal secondary. The primary voltage readings were respectively 30, 35, and 43.

"If you put an a.c. voltage into one winding of an unloaded transformer and measure the voltages appearing across both windings, the ratio between these two voltages is very nearly equal to the ratio of the number of turns of wire on each of the two windings. Since our v.t.v.m. does not load the windings," Mac went on, "we can safely figure that the secondary-to-primary turn ratios of these three transformers are 1/30, 1/35 and 1/43."

"Very interesting, professor," Barney applauded, "but so what?"

"So-o-o-o, there is a connection between the turns ratio of a transformer and the impedance ratio of the windings. It is given by this formula," Mac said as he scribbled on the blackboard at the end of the bench: $N = \sqrt{Z_s/Z_p}$.

"N stands for the secondary-to-primary turns ratio; Z_s is the impedance to be used across the secondary; and Z_p is the impedance or plate load resistance presented by the primary. If we substitute the turns ratio of the first transformer and the four-ohm impedance of the speaker you intend to use across the secondary, we get: $1/30 = \sqrt{4/Z_p}$.

"Squaring both sides gives us: $1/900 = 4/Z_p$.

"When we 'cross-multiply,' we end up with $Z_p = 3600$ ohms. Using the same method, we find that when the other two transformers are used on a four-ohm voice-coil, they will have primary impedances of 4900 and 7396 ohms. What was the load resistance of your 6K6?"

"It was 7600 ohms; so that number three job will be very fine business. Now why didn't I think of that?"

"Probably because you were too busy scheming how you could get me to do the work for you," Mac said dryly. "I suggest you write the turns ratio on each of the transformers. Then if you ever want to know if one of them will work in a particular spot, you can figure it out."

"Check!" Barney said as he carried out the suggestion. "And while you are in such an informative mood, I'd like to ask you something else: what do you think about giving free estimates on radios? I see where a guy across town is advertising this feature."

"I feel about the free estimate as the New England preacher felt about sin: I'm 'agin' it," Mac said promptly. "In the first place, if you will think the thing clear through, you will see that it is neither 'free' nor an 'estimate.'

"What you have to keep in mind," he went on, "is that a service technician has just so many hours of work to sell each week. His income depends directly upon the time he spends with a hot soldering iron in his hand. If he gives some of this time away for free, he simply must get more money for the working time left. That means that the cost of the 'free' estimate is simply passed on to the other customers in the form of higher charges."

"Does making an estimate take much time?"

"If it is of any value, it does. Finding what is wrong with a radio is always the thing that takes both brains and time. Fixing it is usually accomplished by a few passes with the diagonal cutters and the soldering iron. Before you can say how much it will cost to repair a set, you have to restore it to good playing condition. That means tubes must be checked, defective parts located and removed and new ones 'tacked' in place, circuits must be aligned, etc. If these things are not done, your estimate is nothing more than a guess."

"Well, what's wrong with that? It *is* an estimate, you know."

"Yes, *I* know, and *you* know, but the customer doesn't. To him an 'estimate' is actually the determined cost of putting the set into first class shape. Of course, if you find out that you have made a mistake and the bill is less than you anticipated, he is delightfully surprised; but if the cost is more than you calculated, he definitely feels that is a horse on you."

"The thing to do, then, is to make the estimate plenty high."

"That is exactly what happens in free estimating, because the estimate must be made quickly. Not much time can be squandered on a free service. Even a veteran service technician, though, never knows when what looks like a simple blown bypass condenser job will develop a noisy i.f. or output transformer when the set is thoroughly warm; or even a warped speaker cone may show up at this time. The only thing to do is to make the estimate

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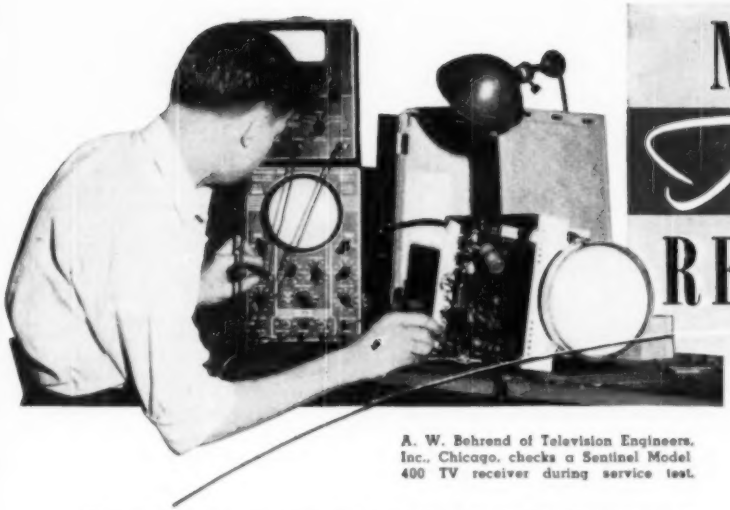
MODERN *Television* RECEIVERS



A. W. Behrend of Television Engineers, Inc., Chicago, checks a Sentinel Model 400 TV receiver during service test.

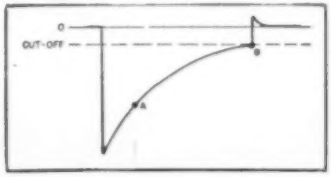
By

MILTON S. KIVER

Part 21. Covering horizontal automatic frequency control systems used in present-day TV receivers.

USE OF the incoming sync pulses to trigger and control the vertical and horizontal sweep oscillators represents the simplest, most economical, and most direct method of controlling the motion of the electron beam in the image tube. Unfortunately, however, this method possesses limitations and disadvantages which outweigh its economy and simplicity. Perhaps the greatest disadvantage is its susceptibility to noise disturbances arising from electrical apparatus and equipment operating in the vicinity of the receiver. The noise pulses, combining with the video signal and extending usually in the same direction as the desired sync pulses, pass through the same stages as the pulses, and arrive at the sweep oscillators. They do their greatest damage when they arrive during the interval between sync pulses. If the amplitude of the noise pulses are sufficiently great, they will trigger the sweep oscillator, initiating a new cycle prior to its proper time. When the vertical oscillator is so triggered, the picture will move vertically either up or down, until the proper sync pulses in the signal can again assume control. If the horizontal oscillator is incorrectly triggered, a series of lines in a narrow band will be jumbled, giving the appearance of streaking or tearing across the image. When the interference is particularly heavy and persistent, the entire picture becomes jumbled and may even be thrown out of horizontal sync permanently, requiring manual adjustment of the horizontal hold control.

Fig. 1. Condenser discharge in grid circuit of blocking and multivibrator oscillators.



Of the two sweep systems in a television receiver, interference is particularly destructive to the horizontal system. To understand why this is so, we must examine the nature of most interference voltages and their effect upon the vertical and horizontal sweep oscillators.

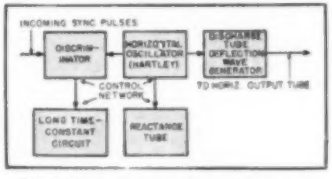


Fig. 2. Block diagram of an a.f.c. system.

Whenever a blocking oscillator is triggered by a sync pulse, for example, its grid, after a short period of conduction, becomes highly negative due to an accumulation of electrons on the grid condenser. This negative voltage is sufficient to keep the tube beyond cut-off until the charge on the grid condenser has decreased to a value at which current is permitted once again to flow through the tube. In most circuits now in use, the condenser discharge occurs in the manner shown in Fig. 1. At the start, the discharge is fairly linear. However, as the amount of charge contained in the condenser decreases, the discharging rate decreases, too, and for more than half the discharge cycle may be said to be exponential. In Fig. 1, the exponential region extends from points "A" to "B."

Now, when the negative charge present on the grid condenser is large, the oscillator is relatively immune to incoming positive pulses. With continued discharge, however, the immunity decreases. Experience has indicated that off-cycle triggering of the oscillator is generally concentrated in the last 15 per-cent of its discharge cycle. This is true regardless of the frequency at which the oscillator is operating. Hence, one would expect to experience equal difficulty with both deflecting systems in the receiver. That this is not so is due to the nature of the noise pulses and the type of filters inserted before each sweep oscillator.

Noise pulses which are most troublesome to television receivers possess high amplitude, but are narrow in width or, what is the same thing, are of short duration. (The energy in noise pulses is distributed over a wide range of frequencies. In order for a peak to occur, the phase relationship among the various frequencies must be such as to permit them to add, forming the high amplitude pulse or peak. This condition, however, usually exists only for a brief interval, which explains the narrow width of these pulses.) When the pulses reach the path leading to the horizontal sweep oscillator they are readily passed because of the short time-constant of the filter leading to the horizontal system. A short time-constant filter is necessary because the horizontal sync pulses themselves have a time duration of only 5 microseconds. On the other hand, the filters leading to the vertical system have a long time-constant and automatically act to suppress the effects of all horizontal sync pulses and

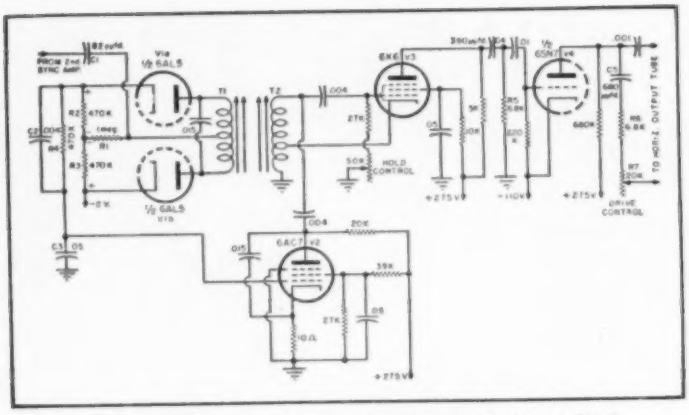


Fig. 3. Schematic diagram of the a.f.c. system shown in block form in Fig. 2.

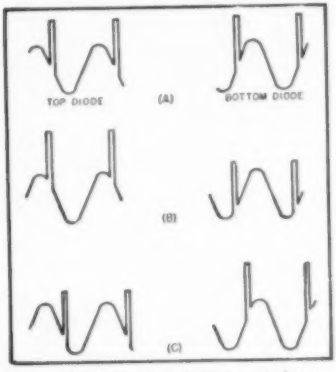


Fig. 4. Combination of the sync pulses and the sine wave from the horizontal oscillator in the discriminator circuit.

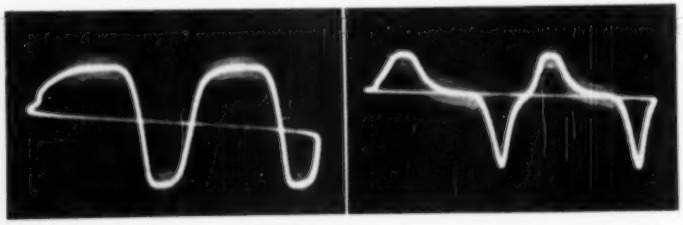
noise pulses of short duration. The presence of this low-pass filter (called an integrating network) is largely responsible for the greater immunity to noise pulses enjoyed by the vertical system. Of course, when a wide noise pulse is received, it contains enough energy to cause off-time firing of the vertical oscillator, but the annoyance caused the viewer from this source is seldom great. To reduce the susceptibility of the horizontal sweep system to noise pulses of any type, several automatic frequency (and phase) control systems have recently been developed.

In each of these special control systems an oscillator is set to operate at 15,750 cycles, and the output of the oscillator controls the horizontal motion of the electron beam across the screen of the image tube. The next step is to synchronize the frequency of this sweep oscillator with the incoming horizontal sync pulses of the signal, and this is accomplished through an intermediate stage known by one of the following names: control tube, a.f.c. phase detector, or horizontal sync discriminator. Whatever the name, the purpose of this intermediate network is to compare the frequency of the incoming horizontal sync pulses with the frequency of the horizontal sweep oscillator in the receiver. If a difference in frequency exists, a d.c. voltage is developed which, when fed back to the horizontal sweep oscillator, changes its frequency until it is exactly equal to that of the incoming sync pulses.

Note that the incoming sync pulses are not applied directly to the sweep oscillator. They are merely compared (in frequency) with the output of the sweep oscillator and if a frequency difference exists, then a d.c. voltage is developed which, when fed back to the sweep oscillator, forces its frequency back into line with that of the sync pulses.

Now (and here is the crux of the whole matter), by having the d.c. control voltage pass through a long time-constant filter before it reaches the sweep oscillator, we can eliminate the effects of most noise impulses and permit only relatively slow changes in frequency of the sync pulses to affect the sweep oscillator. We have thus incorporated into the horizontal sweep system the same type of long time-constant filter that is present in the vertical sweep system.

Fig. 5. (Left) Waveform produced at the plate of V_{1a}. (Right) The same wave after passage through the differentiating network of C_{11}, R_5 of Fig. 3.



Remember, it was through the use of a similar long time-constant filter in the vertical sweep system that this network obtained its immunity from most noise pulses (which have a short time duration). A long time-constant filter could not be used directly in the horizontal system because it would have prevented the desired horizontal sync pulses (together with the noise pulses) from reaching the horizontal sweep oscillator. Hence the need for the indirect method outlined above.

Now let us analyze the various automatic frequency control systems currently in use.

Horizontal A.F.C. Systems

One of the first and still one of the best a.f.c. systems used is shown in block form in Fig. 2. In this circuit, a stable oscillator is set at 15,750 cycles. Connected to the oscillator is a synchronizing discriminator circuit which receives the pulses of the incoming television signal and compares the frequency and phase of these synchronizing pulses with the generated sine wave of the Hartley oscillator. Any variations between the two will produce a d.c. voltage which is applied to the grid of a reactance tube after passing through a long time-constant filter. The plate circuit of this reactance tube is connected across the tuning circuit of the horizontal oscillator, and, as the d.c. voltage at the grid of the reactance tube varies, it will alter the plate current of this tube and with it the oscillator frequency. (It is suggested that the reader refer back to Part 2 of this series, in the May, 1948 issue of RADIO & TELEVISION NEWS, where the operation of reactance tubes was discussed. It was shown there how they can be made to control the frequency of an oscillator.)

The schematic diagram of the circuit is shown in Fig. 3, with parts allocated as follows:

1. V_{1a} and V_{1b} comprise the horizontal sync discriminator circuit.
2. V_2 is the reactance or horizontal oscillator control tube.
3. V_3 is the horizontal sweep oscillator.
4. The long time-constant network consists of C_{11}, C_{12}, and R_5. Now let us see how all these operate as a unit.

The sweep oscillator (V_3) is the well-known Hartley. The oscillator coil, T_2, is inductively coupled to the horizontal sync discriminator by means of a center-tapped primary winding, T_1. Each diode in the discriminator circuit is connected across one-half of T_1, receiving sine wave voltages which are equal in amplitude but opposite in phase. Disregarding R, for the moment, let us see how the voltages appearing across T_1 will affect this circuit.

During one half-cycle, the top end of the secondary of T_1 is positive, forcing V_{1a} to conduct. The current flows from cathode to plate, through the top half of the coil, through R_1 and R_3 back to the cathode again. The voltage developed across R_3 is such that the bottom end is negative and the cathode end is positive. Throughout this interval, V_{1b} is non-conductive because the sine wave voltage applied to its plate is negative.

During the next half cycle, V_{1b} conducts and V_{1a} is cut-off. Current now flows through this tube, up through the bottom half of the secondary winding of T_1, through R_1 and R_2 back to V_{1b} again. The voltage developed across R_2 is such that its top end is negative. If the circuit is operating properly, the voltages across R_2 and R_3 will be equal. However, if these two voltages are added, the resultant will be zero because of the back-to-back placement of the two resistors. In this circuit their voltages are added, which means that no output voltage will be obtained, using this network alone. However, inspection of the circuit reveals that the horizontal sync pulses are also inserted into the circuit by means of C_1 and R_4.

C_1 connects to the output of the sync separator and transfers the horizontal pulses appearing here to R_4 where both V_{1a} and V_{1b} receive this pulse voltage in equal amplitude and phase. Now, let us see how this affects circuit operation.

A horizontal sync pulse can arrive at one of three times. It can appear across R_4 when the sine wave voltage at T_1 is zero; it can arrive when V_{1a} is conducting; or it can arrive when V_{1b} is conducting. If the pulse arrives when the sine wave applied to each tube is passing through zero, there will be no change in circuit conditions. The incoming synchronizing pulse appears across R_4 and combines with the sine wave voltage from each half of the secondary coil T_1 to form the driving voltage for each diode. If the pulses arrive when the sine wave voltage across T_1 is zero, Fig. 4A, then each diode will receive the same pulse voltage and the same amount of rectified voltage will appear across the diode load resistors R_2 and R_3. The total net output from both tubes will be canceled because their load resistors are connected in opposition (back-to-back).

Note again that the reason each diode produces equal voltages across R_2 and R_3 at this moment is because there is no sine wave voltage and each tube receives the same synchronizing pulse voltage from R_4.

Suppose, however, that the pulse arrives at some other instant. Two such situations are shown in Fig. 4B and C. In Fig. 4B, the pulse arrives when the top diode (V_{1a}) is positive and the bottom diode is cut-off. Obviously, then, there will be on the average, more voltage developed across R_2 than across R_3. The average voltage, over one cycle, will be positive and this, fed to V_2, will make its grid more positive. On the other hand, if we consider the situation of Fig. 4C, we see that R_3 will develop the greater voltage and that, on the average, the voltage from the combination will be negative. The effect on V_2 will be different in each instance. It is seen, therefore, that the double-diode arrangement of V_1 is a very sensitive phase discriminator and will develop an output voltage which may be negative, zero, or positive depending upon the phase of the pulses with respect to the voltage generated by the Hartley oscillator.

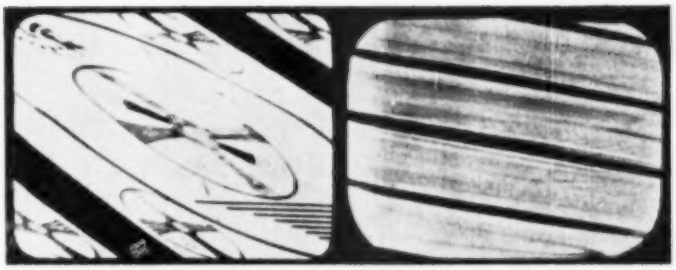


Fig. 6. When the frequency of the horizontal sweep oscillator is not in step with the incoming sync pulses the image will appear in one of these forms.

The d.c. voltage developed in the phase discriminator, together with a fixed negative biasing voltage (−2 volts) is applied through the long time-constant filter of C_5, R_5 and C_7 to the grid of a reactance tube, V_2. This tube is so connected that its plate current is 90 degrees out of phase with the voltage across it and it functions as an inductance. Since V_2 is connected directly across the tuning coil of the Hartley oscillator, changes in its plate current will produce changes in the frequency of the oscillator and force the oscillator to operate at the frequency of the synchronizing pulses. The d.c. voltage developed at the phase discriminator is fed directly into the grid of the reactance tube and thereby controls the plate current flow. In this manner, all differences in frequency between the synchronizing pulses and the Hartley oscillator are instantly corrected.

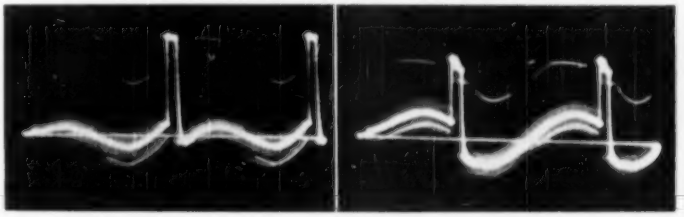
C_5, R_5 and C_7 smooth out any rapid changes in d.c. developed in the phase discriminator by noise pulses. Only the relatively slow changes in frequency caused by differences between the horizontal oscillator and the incoming horizontal sync pulses are permitted to reach V_2. A hold control is available in case the oscillator frequency should be too far from the frequency of the incoming pulses to permit lock-in.

Horizontal Discharge. A horizontal discharge tube, V_3, follows the horizontal oscillator and produces, in its plate circuit, the peaked deflecting voltage which is needed for the horizontal deflecting coils. In V_3, the Hartley oscillator is connected between the cathode, control grid, and screen-grid. The plate circuit contains only a resistance, and consequently the waveform found here is not the symmetrical sine wave that would be produced by a resonant circuit; rather it has the form shown in Fig. 5 (left). The peak-to-peak voltage on the grid of V_3 is about 130 volts. This grid swing produces a square wave in the plate circuit, with a peak-to-peak voltage of 225 volts. The square wave is differentiated by C_8 and R_{11}, resulting in the waveform shown in Fig. 5 (right). The positive portion of the differentiated wave is sufficiently sharp to trigger the discharge tube. Normally, the discharge tube is cut-off due to bias produced by grid rectification of the pulses from the oscillator. The positive tip of each pulse overcomes this bias and drives the tube into heavy momentary conduction. During this period, the plate voltage of V_3 falls to cathode potential and C_8 discharges. The discharge, however, is not complete due to R_8 and R_{11}, both of which are in series with C_8.

When the conduction period of V_3 ends, some voltage remains on C_8 and condenser charging starts from this point and rises slowly until the arrival of the next positive pulse. The deflection waveform produced by this action is received by the following horizontal

(*Continued on page 128*)

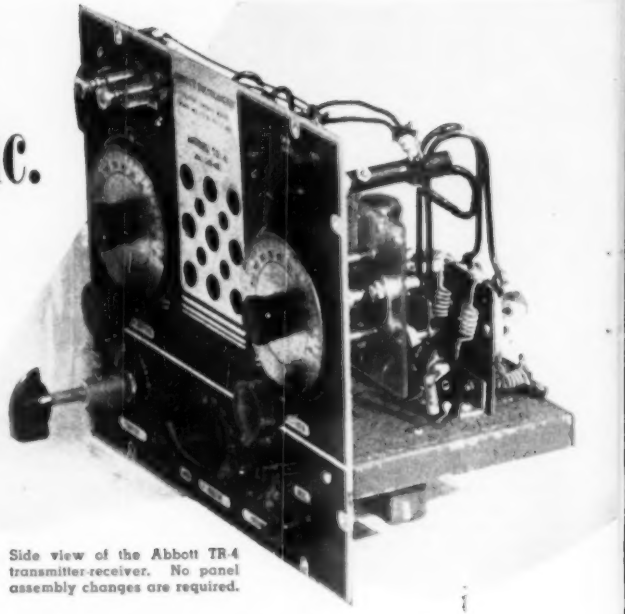
Fig. 7. The waveforms obtained at pin 2 (shown at left) and pin 7 (right) of the 6AL5 phase discriminator tube (V_2) in Fig. 3. These represent the normal waveforms which will be recorded when a signal is being received.



CONVERTING The TR-4 for 420 mc.

By D. H. ROGERS,* W2MLF

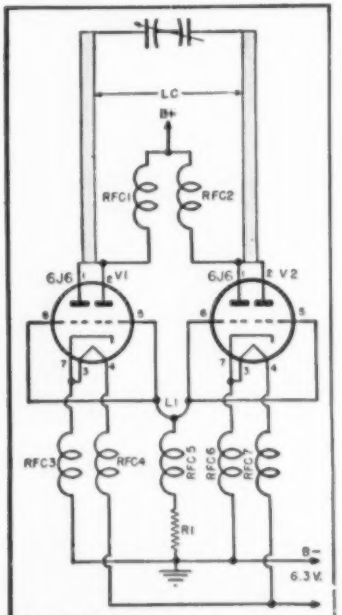
It is easy to convert this Abbott transmitter-receiver to 420 mc. The only changes required are in detector and oscillator circuits.



Side view of the Abbott TR-4 transmitter-receiver. No panel assembly changes are required.

THE *Abbott* transmitter-receiver TR-4 has earned a good name on two meters, but its day is past. Two meters has gone crystal control, and neither the modulated oscillator nor the superregenerative detector of the TR-4 is equal to present conditions.

Fig. 1. Transmitting oscillator circuit.



R$_1$—4700 ohm, 2 w. res.
LC—Half-wave transmission line (See text)
L$_1$—Grid coil (See Fig. 3B)
RFC$_1$, RFC$_2$, RFC$_3$, RFC$_4$, RFC$_5$, RFC$_6$, RFC$_7$—6 t. #20 d.c.c. on 3/16" diam. form, $\frac{3}{8}$" long

So a once sweet portable rig gathers dust on the shelf, while the band is given over to the SCR-522, the ARC-5, and the superheterodyne converter.

Dust It Off For 420

But anything goes on the 420 megacycle band. Crystal multipliers and superheterodynes are not required under present conditions of band population. The TR-4 will do the job, and is a natural for the ham who wants to pioneer. A few hours' work, and you can get on and operate, share the thrills of exploring a new band, analyze new conditions, and set new records.

The conversion described here requires replacing the detector and oscillator circuits, but uses a minimum of new parts. Its simplicity and effectiveness result from using half-wave lines. They are large enough to work with conveniently, and permit retaining the original tuning condensers, which are modified by splitting the stator plates and using the outer ends of the line elements as stator posts.

At these high frequencies an ordinary tuned circuit is hard to handle. The coil shrinks to a single turn in the form of a hairpin loop, and is equivalent to a quarter-wave line, a large part of which is inside of the tube.

Condenser leads must be prohibitively short, and the condenser has to be tapped on part way down the line, because it cannot connect any nearer the tube elements than the socket. Under these conditions it is hard to get good performance or to cover the whole range from 420 to 450 mc.

With a half-wave line, however, we can place the tube at one end and the condenser at the other, with the point of maximum current falling at the center. The condenser leads then become part of the line as effectively as do the tube leads.

Oscillator Conversion

The transmitting oscillator uses push-pull 6J6 tubes with a plate line and a grid coil. The tuned-plate, tuned-grid circuit is shown in Fig. 1 and the mechanical details in Fig. 3. The terminals of the HY-75 socket are used as tie points for the grid leak and heater leads. The tube shelf is mounted exactly 1$\frac{1}{2}$" above the chassis and the line elements are anchored to the socket terminals with #22 wire before soldering. They are twisted in slightly from the condenser to get proper spacing (caution—do not bend them in place, to avoid cracking the ceramic insulator) and the condenser plates are soldered directly to them. The new stator plates are made by cutting the old one in two, removing a $\frac{1}{16}$" strip to provide clearance.

Fine frequency adjustment is accomplished by bending the grid loop to increase or decrease the area it encloses. Major changes in calibration require shortening or lengthening the line. The range of the dial is controlled by the plate spacing in the condenser. In the model, the band covers the space from 5 to 85, frequency increasing with reading. Here a $\frac{1}{16}$" shim was used to space the stator plates from the rotor plate during soldering.

The current maximum in the line can be located by touching one of the

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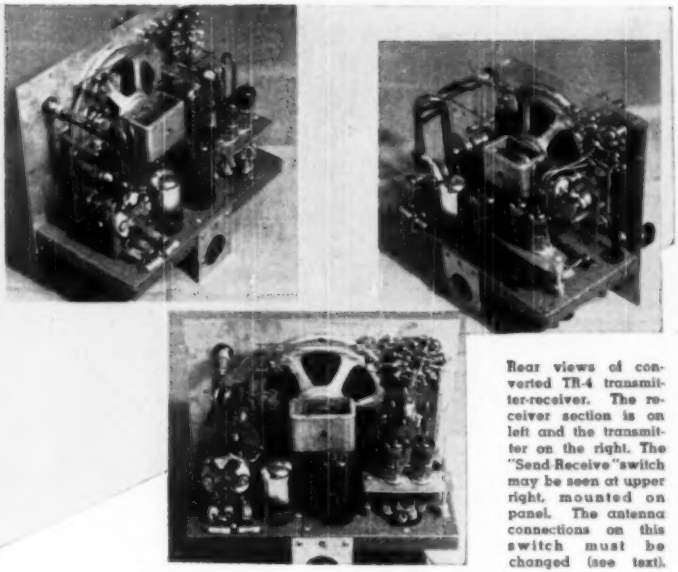


Rear views of converted TR-4 transmitter-receiver. The receiver section is on left and the transmitter on the right. The "Send-Receive" switch may be seen at upper right, mounted on panel. The antenna connections on this switch must be changed (see text).

elements while watching the plate milliammeter. This point of no-reaction will be found a short distance above the sockets. The antenna should be coupled here. The coupling loop is supported by an insulator mounted on a long bolt to permit adjustment. It must be fairly loose to secure good speech quality at high modulation levels. Under these conditions the transmitter draws about 50 ma. at 300 volts. This rises to 75 ma. if oscillation is stopped by placing a finger on a hot point of the line.

Detector Conversion

The superregenative detector uses a 955 acorn tube with a half-wave tuned line. The circuit is shown in Fig. 2 and the mechanical details in Figs. 4A and 4B. The separate cathode choke is used to avoid introducing hum voltage into the detector when operating from a.c. power. The values of grid leak and condenser C_1 (Fig. 2) were chosen for the best combination of sensitivity and smooth operation. To further this end it was found necessary to remove the original .004 μfd. mica phase-shifting condenser between the tube and the audio transformer, and to add a 5000 ohm resistor across the primary. The plate supply bleeder was also adjusted to provide a higher voltage range than that orginally afforded.

The detector line is slightly skewed to secure clearance between the tube and the 7F7 first audio. This shaping is easily accomplished by twisting the ends of the elements slightly after forming. The close spacing provides better performance than wide spacing, probably by impedance matching the tube lead inductance and element capacity. It also affords a means of fine frequency adjustment. The band-setting can be trimmed by adjusting the spacing at the top of the bend, and held by cementing in a small block of polystyrene, as shown in the photograph.

The condenser plates are cut and mounted like those in the transmitter section, except for the use of a $\frac{1}{32}$" spacing shim in order to secure wider frequency coverages. The additional range is desirable to allow for detuning by the antenna and to help in locating the other fellow in case he's out of the band. (It shouldn't happen, but pioneering involves risk.) In the model, the band extends from 25 to 80, with dial set for readings to increase with frequency. Dead spots were encountered until the 100 μfd. heater supply bypass condensers were added at the chassis and the "Send-Receive" switch was reconnected.

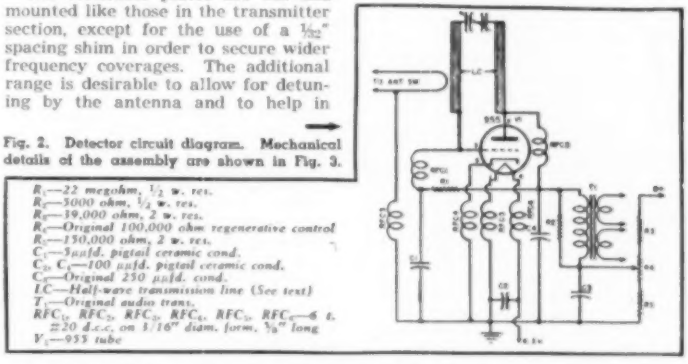


Fig. 2. Detector circuit diagram. Mechanical details of the assembly are shown in Fig. 3.

R_1—22 megohm, ½ w. res.
R_2—5000 ohm, ½ w. res.
R_3—39,000 ohm, 2 w. res.
R_4—Original 100,000 ohm regenerative control
R_5—150,000 ohm, 2 w. res.
C_1—5 μμfd. pigtail ceramic cond.
C_2, C_3—100 μμfd. pigtail ceramic cond.
C_4—Original 250 μμfd. cond.
LC—Half-wave transmission line (See text)
T—Original audio trans.
RFC_1, RFC_2, RFC_3, RFC_4, RFC_5, RFC_6—6 t. #20 d.c.c. on 3/16" diam. form, ⅛" long
V_1—955 tube

"Send-Receive" Switch

No change need be made in the lower switch section except to short out the HY-75 filament contacts so that the 6J6's will stay hot. The antenna section, however, must be completely rewired according to Fig. 4C.

The change provides a short circuit across the receiver antenna coil during transmitting, and across the transmitter antenna coil during receiving, to prevent absorption. This is particularly noticeable in the receiver as a dead spot which can be tuned with the transmitter dial.

The antenna coupling coil should be changed as shown, so that it can be coupled to the current maximum of the grid element. One side of it must also be grounded through an r.f. choke to prevent interference from local broadcasting stations from reaching the high impedance grid circuit.

One important precaution must be observed at these ultra-high-frequencies. Put the unit back in the metal box and *tighten all screws* before attempting to judge performance. Radia-

(*Continued on page* 130)

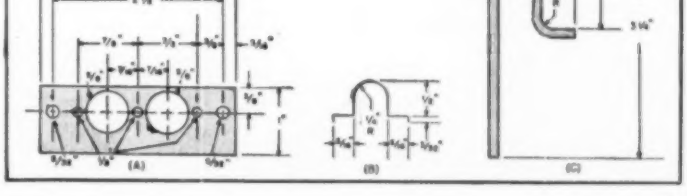


Fig. 3. (A) Shelf for transmitting tubes, drilled for Cinch sockets. Made from 1/16" phenol fabric. (B) Push-pull grid coil for transmitter. Made from #20 A.W.G. tinned copper wire (C) Transmitter line element (see text for twisting). Made from ⅛" copper rod or wire.

Make Your Own SELF-GENERATING PHOTOCELL

By
GUY DEXTER

Fig. 1. External view of the exposure meter using a home-made photocell. The Weston Sensitrol line of microampere relays can be operated directly from this selenium self-generating cell.

Parts of a small selenium rectifier are used to build this compact "Photronic" type cell.

THE electronic gadgeteer knows of many interesting experiments to perform and of serviceable devices to build using the electric eye. Just a few of these are intrusion (burglar) alarms, "customer announcers" for stores, passing object counters, safety devices for machinery, headlight-controlled garage door openers, room door openers, light meters, photographic exposure meters, color matchers, light-beam telephones, photoswitches for turning on artificial lights when sunlight dims, and speed (revolutions-per-minute) counters. The owner of an electric eye need never be lost for something new to try.

There are three principal types of electric eyes. They are: (1) phototubes, (2) photoconductive cells, and (3) photovoltaic cells. Of the three, the latter type is especially attractive to the experimenter because it is self-generating. That is, the photovoltaic cell will produce a voltage, without the aid of any external battery or power supply, whenever light strikes it. The self-generating photocell is the type found in the familiar photographic exposure meter.

Self-generating photocells are rather expensive for the amateur electronic experimenter. For this reason, they seldom are bought for the prime purpose of amateur experimentation. However, few amateurs know that a good photocell of this type can be home made very easily. A simple light-sensitive element for a home-made cell, requiring no chemical processing by the builder, is a plate taken from one of the small selenium rectifiers widely used at present in transformerless radio power supplies. The 150 milliampere size rectifier has five plates, each a little larger than 1 inch square. When electrical contact is made to each of the two faces of one of these plates, and the selenium-coated face is illuminated, a small but useful voltage will be set up. The plain metal face will be positive, and the selenium-coated face negative. This voltage will actuate a sensitive meter-type d.c. relay directly, or it may be applied to the grid input circuit of a vacuum tube to operate a heavier relay. It will also deflect a d.c. microammeter directly.

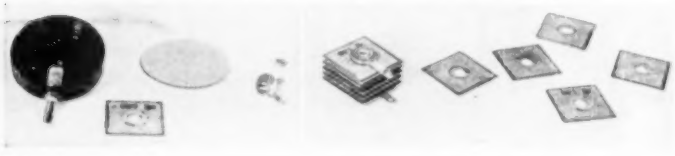
A complete, rugged photocell is obtained by mounting the rectifier plate securely in a protective housing and providing output terminals. The finished cell may be used in a variety of experiments or may be installed permanently in electronic equipment. A single 150 milliampere selenium rectifier costing less than one dollar will furnish enough plates to build five photocells. This article describes the simple construction of a simple self-generating photocell and of an exposure meter using one of the cells.

Description of the Home-Made Cell

Appearance and constructional details of the photocell are shown in the photographs (Figs. 2 [left] and 5) and the working drawing (Fig. 4A).

The unit is 2 inches in diameter and ½ inch thick. "Watchcase" type housing is employed. Fig. 5 (inset) shows the completed cell before its transparent window-disc was cemented in place. A banana plug is provided for the double purpose of plugging the unit into a circuit and holding it in position. A screw terminal with solder lug, on the back of the case (see Fig. 5), is the second photocell connection. The case is a screw-on jar cap made of black plastic. Jar tops of this type can be obtained at hardware and kitchen furnishings stores. After assembling the cell, the open front of

Fig. 2. Photocell parts ready for assembly. (Left) Jar top has been drilled and the banana plug and contact strip installed. Other parts (l. to r.) are: rectifier disc, transparent window-disc, and contact lug-screw assembly. (Right) Small selenium rectifier provides the light-sensitive plates for five photocells.



the case is covered with a protective disc of transparent, colorless celluloid or other plastic which admits light rays but protects the cell from dust and vapors.

Construction of the cell is shown in Fig. 4A. The light-sensitive rectifier plate is fastened to the inside back of the jar top with its selenium-coated face exposed to receive incoming light rays. Contact to the selenium surface is made by means of a solder lug bent downward to rest firmly upon the coated surface of the plate. The lug is held in place by a 6-32 screw which passes through the large clearance hole in the center of the rectifier plate and through an aligned hole in the back of the jar top. An outside nut secures this screw, preventing contact between it and the sides of the clearance hole in the rectifier plate. Under this nut is a second solder lug (see Figs. 4A and 5) for connection of the selenium-coated surface to the external circuit. The bakelite washer separating the screw end of the inside lug from the selenium surface is necessary since the selenium coating on most rectifier plates does not extend unbroken to the edges of the central hole. Without the washer the lug would touch the uncoated portion of the metal plate and short-circuit. Connection is made to the uncoated rear face of the rectifier plate by means of a narrow, flat strip of brass or phosphor bronze attached to the banana plug. Fig. 2 (left) shows the spring strip mounted in place prior to bolting the rectifier plate over it.

Building Instructions

(1.) Secure a 100- or 150-ma. selenium rectifier. This unit must be an *unpainted* model. (Several commercial rectifiers are completely dipped in paint which conceals the light-sensitive selenium surface from light rays, and these models are unsatisfactory for photocell use. The paint probably can be removed with paint remover or lacquer thinner, but the author hesitates to recommend a paint-stripped unit, since he has not tested one). The author used a Seltron 5P1 rectifier, made by *Radio Receptor Co.* This unit has a silvery conductive spray on the selenium surface but is not paint covered, and responds very satisfactorily to light rays. Remove the plates from the rectifier by carefully drilling or cutting out the central eyelet which holds the unit together. Fig. 2 (right) shows a complete rectifier alongside five plates obtained by tearing apart a similar unit.

(2.) Be careful not to scratch or cut the selenium-coated surface of the rectifier plate. Using fine emery cloth or sandpaper, clean the uncoated rear face of the plate so as to insure good electrical contact.

(3.) Secure a 2-inch-diameter black plastic jar top. Drill a 6-32 clearance hole through its center and an identical hole through its rim. The first hole is for the plate-holding back screw; the second one for the banana plug. Fig. 5 clearly illustrates this assembly.

(4.) Cut a flat strip of thin brass or phosphor bronze about ¾ inch long and ¼ inch wide. Drill a 6-32 clearance hole near one end of this strip and make a right-angle bend in the

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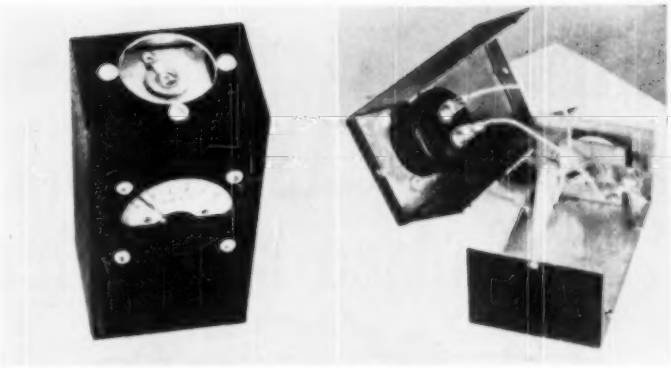


Fig. 3. (Left) The photocell plate peeps through a relatively large hole cut in the end of the box. The meter deflection was caused by the photographic lamps. (Right) Simplicity of construction and wiring are apparent in this illustration.

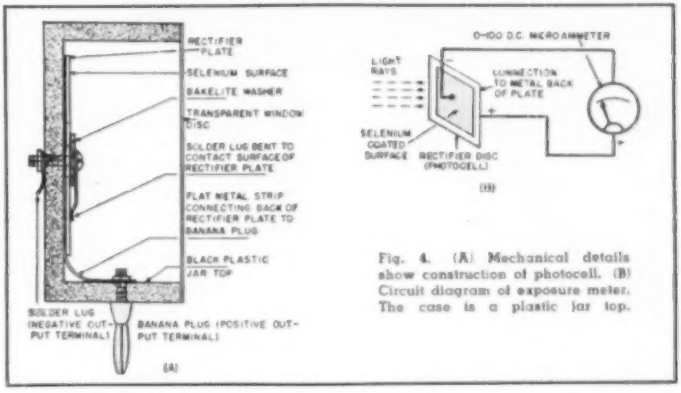
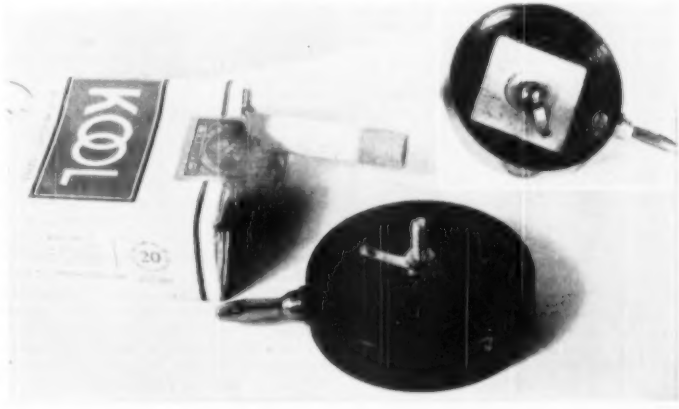


Fig. 4. (A) Mechanical details show construction of photocell. (B) Circuit diagram of exposure meter. The case is a plastic jar top.

Fig. 5. Both output terminals are visible in this photograph. Cigarette package shows comparative size of completed cell. Inset shows the selenium rectifier plate bolted in place. The banana plug, contacting the back of the plate, is the positive output terminal. The lug-holding screw, contacting the selenium surface, provides the negative output terminal at the rear of the case.



Eliminating BROADCAST INTERFERENCE Caused By TV Receivers

By JACK NAJORK, W2HNB

Technicians have a new servicing problem in TV interference. Here's how to whip this problem.

AS WITH any other rapidly advancing art, television is having its normal run of growing pains and the service technician often finds himself suddenly confronted with an entirely new problem, the likes of which have never been encountered in the more stable realm of broadcast receiver service work.

One of the more serious problems being encountered by the service technician is broadcast interference caused by television receivers. This situation usually crops up in apartment houses and congested residential sections where broadcast receivers are operated in close proximity to television receivers using the popular "flyback" type of high-voltage power supply.

The interference manifests itself as a series of "birdies" or rough carriers, spread across the entire broadcast band at intervals of approximately 15 kilocycles. It is caused by harmonics of the horizontal oscillator frequency (15,750 c.p.s.) in the TV receiver being radiated with sufficient strength to be picked up at the broadcast receiver. These harmonics are usually tuned in at broadcast band frequencies, although there is also a possibility that they can find their way into the i.f. channel of the broadcast set and thereby cause a continuous whistle or heterodyne, irrespective of the broadcast receiver dial setting.

The horizontal output tube in the TV receiver employing the "flyback" type power supply generally operates as a class B amplifier and its output is, therefore, rich in harmonics. This condition is made even worse by the transient oscillation which takes place during flyback time. It is this transient oscillation which is used to generate the high voltage in the flyback type power supply, hence the problem cannot be solved by attempting to change the operating conditions of the horizontal output tube.

There are several effective measures which can be taken, however, which will usually eliminate the interference entirely or reduce it to a negligible level.

It is first necessary to determine whether the interference is being radiated by the TV antenna and transmission line or by the TV receiver itself. This can be checked quickly by disconnecting the transmission line at the antenna terminals and moving it several feet away from the TV receiver. If the interference persists, direct radiation is taking place from the TV receiver itself. If disconnecting the transmission line reduces or eliminates the interference, then the first step is the introduction of a simple high-pass filter between the TV receiver antenna terminals and the transmission line.

Although most TV receivers use some form of high-pass filter at the input to the front end to prevent low frequency signals from getting *into* the tuned circuits, these filters are sometimes not too effective in preventing the radiation of harmonics of the horizontal frequency. This is particularly true if the filter circuit is located some distance from the antenna terminals and an open wire line such as 300 ohm cable is used between these two points. For this reason, the filters shown in Figs. 1A and 1B should always be installed directly at the antenna terminals of the TV receiver rather than at the input to the front end.

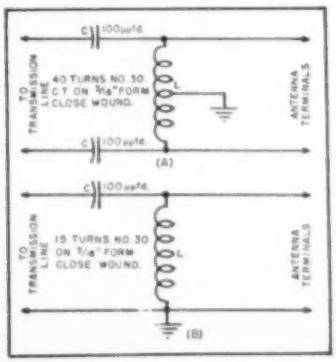
Fig. 1A shows a simple high-pass filter suitable for use with sets having a balanced 300 ohm input. This filter, incidentally, will also be helpful in preventing low frequency interference from finding its way into the TV circuits but it will have no noticeable effect on the reception of regular TV channels, high or low.

The 100 $\mu\mu$fd. condensers present a high impedance path to low frequency signals but their reactance at television frequencies is negligible. The center-tapped choke provides an easy path to ground at frequencies below the television channels but has sufficiently high reactance at the higher frequencies to offer very little attenuation. In weak signal areas it is best not to use lacquer or cement to hold the choke windings in place because this will raise the distributed capacity of the choke and introduce slight losses on the higher TV channels. The filter should be mounted as close as possible to the antenna terminals of the TV set and the center-tap connection of the choke should be as short as possible.

Fig. 1B shows a filter suitable for receivers having unbalanced 72 ohm input circuits. Transmission line radiation is most severe with the open type 300 ohm cable and it will be found that receivers using shielded transmission lines usually cause interference by direct radiation from the chassis rather than through the antenna system. If the TV antenna proper is close to the broadcast an-

(Continued on page 104)

Fig. 1. (A) Simple high-pass filter used between antenna terminals of TV receiver and 300 ohm transmission line to prevent radiation of horizontal frequency harmonics by transmission line and antenna. (B) A simple high-pass filter suitable for use with TV receivers having 72 ohm unbalanced input.



PRINTED CIRCUITS

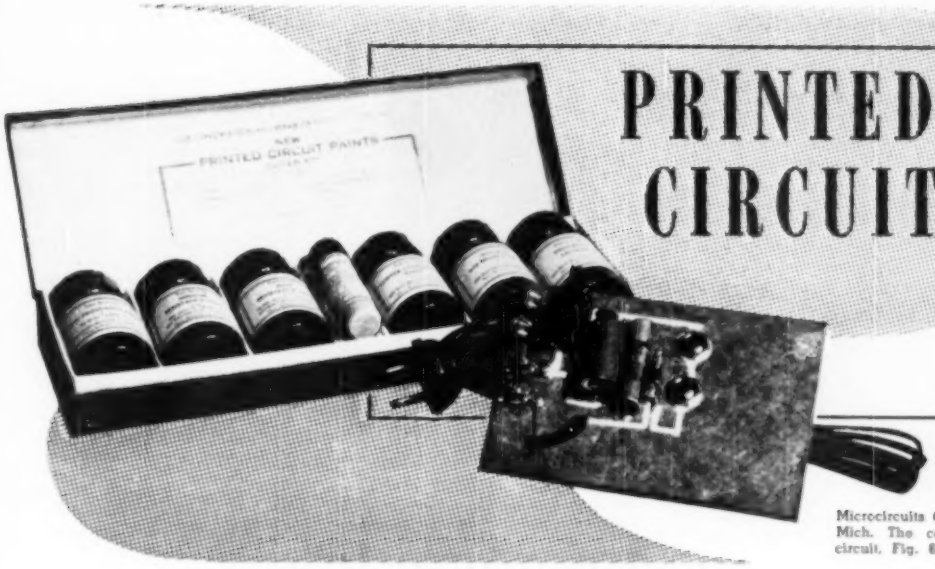


Fig. 1. Kit of printed circuit paints made by Microcircuits Co. of New Buffalo, Mich. The code oscillator (see circuit, Fig. 6) is built from kit.

By JOHN T. FRYE

Part 2. A discussion of the techniques and equipment used in making printed circuits for home-built units.

PART 1 of this article, appearing in the December issue, presented the various methods by which these miniature circuits are produced commercially. Now we are ready to roll up our sleeves and get down to the pleasurable business of making our own printed circuits.

A quick review of all the methods of producing these circuits reveals that the simple brushing of conductor and resistor paints onto a base plate is the most practical way to start experimenting. Such a system requires an absolute minimum of equipment; yet it produces results that compare quite favorably with the much more complicated methods used in mass production.

The first things we need are conductor and resistor paints. There are two kinds of conductor paint in general use—copper and silver. The copper paint is cheaper, but its resistance increases with age to a terminal two to five ohms per inch. Silver paint, on the other hand, will maintain its resistance of only a few tenths of an ohm per inch for years. In all circuits except temporary experimental ones, the silver paint is well worth its additional cost.

Next, we need two or three different mixtures of resistor paint. More than one degree of conductivity is needed if we are to be able to draw a wide range of resistance values and still keep our resistors of reasonably uniform size.

We shall also need a solvent material that can be used to thin the paints when they become too thick through evaporation, and to clean the brushes. In addition, we should have a good insulating lacquer, the uses of which will be described later. Finally, we must provide ourselves with base materials upon which we can draw the printed circuits.

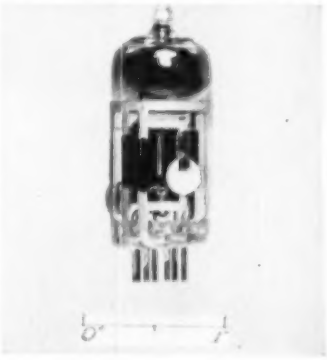
We *could* prepare our own paints, but most of us do not have the materials, facilities, nor inclination to do this. Fortunately, it is not necessary as the paints can be purchased already prepared. The *E. I. duPont de Nemours Co., Inc.*, the *Metaplast Co., Inc.*, and the *Acheson Colloids Corporation* are among the companies that supply these paints commercially, but it is doubtful if they would be interested in supplying small quantities. The *Microcircuits Company* of New Buffalo, Michigan, however will supply any quantity of needed materials. In fact, they sell a "kit" of supplies for the beginning experimenter that is illustrated in Fig. 1. This kit includes a bottle of copper paint, another of silver paint, three resistor paints of different degrees of conductivity, a bottle of lacquer, and a bottle of thinner and brush-cleaner.

Just about any material, if it is properly prepared, can be used as a base upon which to paint the circuits. The only requirements are that the material be rigid so that it will not flex and cause the lines painted upon it to crack; that its surface be not too rough or porous; that it be chemically inert; and that it have an insulated surface or one capable of being insulated.

The paints do not stick too well to glass unless the surface has been roughened by sand-blasting or etching; but the experimenter can overcome this by applying a thin coat of lacquer to the glass and then painting his circuits on this coating. Fig. 2 shows a complete two-stage amplifier circuit painted on the envelope of a 6J6 tube.

Asbestos board, fiber-board, etc., can be used; but if the surface of this porous material is not treated, absorption will cause the characteristic

Fig. 2. Two-stage amplifier painted on the glass envelope of a twin-triode 6J6 tube.



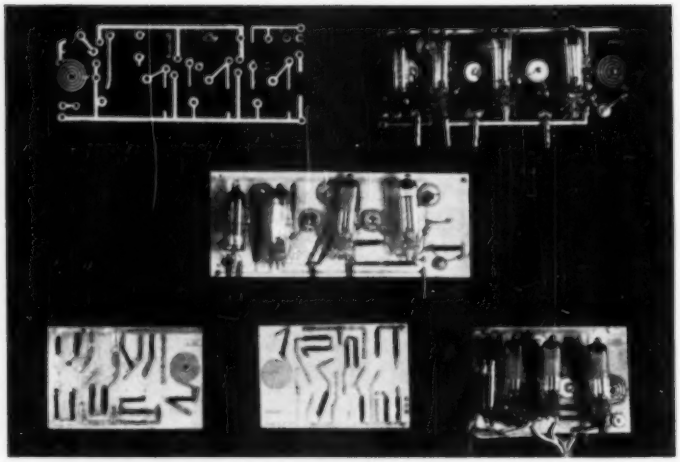


Fig. 3. (Top row) Four-tube receiver printed on 3/32" Lucite plate, 2" wide and 5" long. At left is stencilled silver wiring with complete receiver at right. (Center) Four-tube receiver printed on thin steatite plate. (Bottom row) Development of a four-tube receiver on thin steatite plate 2" wide and 3" long. The plate at left had paints applied with a brush except for spiral inductances. The center one was stencilled. Leads from the complete receiver at right connect to batteries and speaker. All receivers use square law detector, two stages of pentode amplification, and triode output.

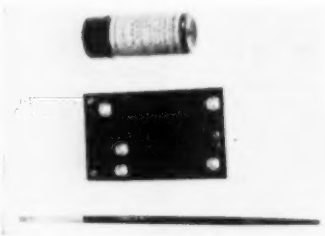


Fig. 4. A base plate all ready for the painting of conductors. Note that brass rivets are used as terminals and to form crossovers.

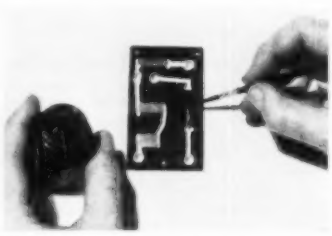


Fig. 5. Actual painting of resistors. Note how resistance lines are lapped over the conductor lines and preparation of abutments.

☆ ☆

Table 1. Resistance and wattage values for various sizes of resistors painted with one kind of resistor paint. The intersection of the width and length values gives the resistance value above and the wattage rating below. For example, a resistor 1/4" wide and 3/4" long has a resistance of 1500 ohms and a wattage rating of 1.8.

Width (Inches)	Length in Inches Resistance values in ohms							
	1/2"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"
1/2"	500 .15	1000 .3	1500 .5	2000 .6	2500 .75	3000 .9	3500 1.1	4000 1.2
1/4"	250 .3	500 .6	750 1.0	1000 1.2	1250 1.5	1500 1.8	1750 2.2	2000 2.4
3/8"	167 .5	335 .9	500 1.5	665 1.8	830 2.2	1000 2.8	1165 3.3	1330 3.7
1/2"	125 .6	250 1.2	375 2.0	500 2.5	625 3.0	750 3.7	875 4.4	1000 5
5/8"	100 .8	200 1.6	300 2.4	400 3.1	500 3.8	600 4.6	700 5.5	800 6.2
3/4"	84 .9	168 1.9	252 2.9	333 3.7	417 4.5	500 5.5	584 6.6	665 7.5
7/8"	72 1.1	144 2.2	216 3.4	285 4.2	357 5.2	429 6.4	500 7.7	570 8.7
1"	63 1.2	125 2.5	187 3.7	250 5.0	313 6.2	375 7.5	438 8.7	500 10.0

values of resistors painted upon it to be greatly changed. A sealing coat of lacquer will avoid this trouble.

The paint adheres very well to plastics because the solvent used causes the surface of many of them to become slightly dissolved. A heat-resisting coating on a metal base works quite well, for the metal aids in carrying the heat away from the resistors. Two coats of lacquer will provide such a coating.

No matter what base is used, the cardinal principle is that the surface receiving the paints must be absolutely clean. The slightest trace of grease, even that left by the touch of a finger, will prevent the paint from making a good bond with the base. Lacquered surfaces must not be touched. Glass, porcelain, and plastics can first be cleaned with alcohol, gasoline, or carbon tetrachloride, then washed with soapy water, and finally thoroughly rinsed with clear water and dried.

Laying out the circuit should be done with great care. Conducting lines should be as short and direct as possible. "Cross-overs" of conducting lines should be held to a minimum. Correct spaces should be left for resistors. Terminals should be provided in the form of rivets. The possibility of inductive and capacitive effects between adjacent conducting lines must be considered.

All of these details should be worked out with paper and pencil, and then the complete diagram can be transferred to the base plate by means of carbon paper. When actually drawing on the base with a pencil or drawing ink, it must be remembered that these lines are conductors in themselves and must not be left where they will connect parts of the finished circuit.

Fig. 4 shows a base plate of laminated paper and phenolic material all ready for painting. Brass eyelets have been inserted at the proper places to furnish terminals; the small brush and the silver conducting paint are all ready to paint the conducting lines.

Before starting to brush on the paint, though, it is important to see that the paint is very thoroughly mixed. Remember our "paint" is composed of metal particles and a carrying solution. When undisturbed, the heavy particles settle to the bottom and stay there. A line drawn with a brush dipped into a bottle of this undisturbed paint would consist chiefly of non-conducting thinner and be a very poor conductor.

Lengthy stirring will mix the paint, but that makes it necessary to have the bottle uncorked while doing the stirring. The thinner used is extremely volatile so that the drying time will be short, and if the bottle is left unstoppered for any appreciable length of time, the paint becomes too thick to brush. A temporary cover should always be set on top of the bottle of paint except when the brush is inserted. A quick stirring followed by

lengthy shaking of the stoppered bottle is the best way to mix the paint, and it should be kept mixed by repeated shakings during the painting process.

The conducting lines should be carefully drawn along the direction of current flow, care being taken to make the lines of as nearly uniform thickness and width as possible. The paint should be run up over the edges of the eyelets to make sure that a good electrical connection is obtained at these points. "Abutments," across which the resistors will be bridged should be drawn in as shown in Fig. 5.

The manufacturer of the paint used will provide information on the drying time required. In the case of the *Microcircuits* silver paint, the air-drying time is one half hour to an hour. Copper and resistance paints take considerably longer. The process can be speeded up by mild heating, not over 150° F., in an oven or with an infrared lamp. Greater heat than this may result in "bubbling" of the paint.

When the silver paint is dry, you are ready to paint in the resistances. Painted resistors are figured from a standard resistor one inch square, painted with a single thickness of the given paint, and having a heat dissipation of ten watts. As you know, the resistance of such a resistor will be directly proportional to the length measured along the direction of current flow and inversely proportional to the width and the thickness. The wattage rating varies directly with the surface area.

Reductions in the dimensions of this standard square will result in other resistors whose resistance and wattage values are in accord with these laws. The resistance may be higher or lower than that of the standard resistor, depending upon whether the "width" or the "length" of the square was reduced. Table 1 shows the different values of resistance and wattage obtained when a standard resistor of 500 ohms is reduced in $\frac{1}{8}$" steps along its width or length or both. In the same way, when you know the resistance of a standard one-inch-square resistor painted with a particular resistance paint, you can always estimate the dimensions of a needed resistor whose value lies within the range of that particular paint.

The resistors should be drawn with a thick, even layer of paint that overlaps the silver paint by at least $\frac{1}{16}$". If the resistor is of uneven thickness, the heat generated by the I^2R losses will be unequally distributed and may cause the resistor to be damaged when operated near its maximum wattage rating.

After the resistors have dried for fifteen minutes, they may be baked at up to 250° F. without danger of bubbling. The cold resistance of a resistor that has been baked at 200° F. is about one half that of the same resistor with normal air-drying; so the method of drying should be taken into account when calculating the size of resistors.

It is impossible to avoid having some crossovers of conducting lines, and there are two ways of making them: first, you can bridge one of the lines with a piece of paper that has been soaked in an insulating varnish, shellac, or lacquer; and, after it has thoroughly dried, you can paint the other line right over the top of this bridge. The other method is to place a brass or copper rivet on each side of the line to be crossed and then carry the crossing line down through one of these rivets to the opposite side of the base plate, along a conducting line to the other rivet, and then back up. This latter scheme is more permanent and is less likely to cause trouble because

(*Continued on page 149*)

Electrical Characteristics	CK-505AX Pentode Voltage Amplifier	CK-503AX Pentode Output	2E31, 2E32 Pentode Shielded R.F.	2E41, 2E42 Diode Pentode	2G21, 2G22 Triode Heptode	CK-509AX Triode Voltage Amplifier
Fil. Volt. (d.c.)	625	1.25	1.25	1.25	1.25	625
Fil. current (in ma.)	30	46	90	30	60	30
Plate volt.	30	46	22.5	22.5	22.5	45
Screen volt	30	46	22.5	22.5	22.5	
Control grid volts*	0	-4.5	0	0	0	0
Peak a.f. grid volt.		4.5				
Transconductance	175	500	900	400	60 Gc	160
Plate res. (in meg.)	1	.12	.36	.25	.5**	.15
Plate current (in ma.)	.15	1.25	.35	.4	.2	.16
Screen current (in ma.)	.05	.4	.3	.15	.3	
Load res. (in meg.)	1	.03				1
Screen res. (in meg.)	3	0				
Power output (in mw.)		25				
Voltage gain	35					16
% distortion		10				
Max. grid-plate cap. (in $\mu\mu$fd.)			0.18	.10	.065***	
Osc. plate volt					22.5	
Osc. plate current (in ma.)					1	

*With 5 meg. grid res. connected to F.
**Approx. conversion plate res. ***Signal grid-to-mixer plate capacitance.

Table 2. Characteristics of some typical subminiature tubes used in printed circuits.

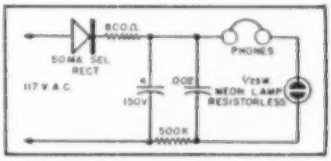
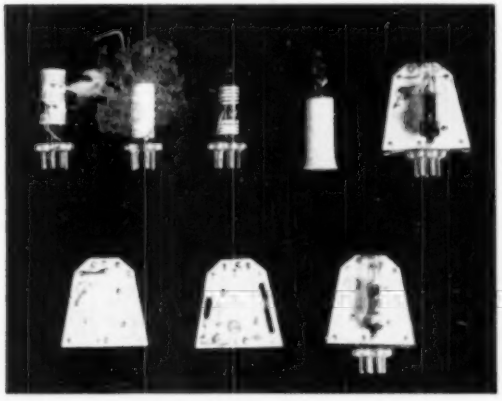
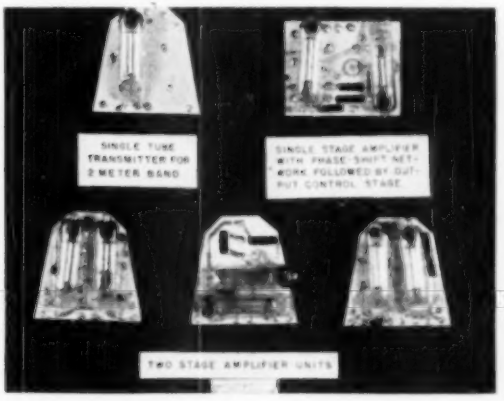


Fig. 6. Circuit diagram of the code oscillator shown in the photograph of Fig. 1.

Fig. 7. (Left) Five types of grid-modulated 132-144 mc. transmitters. The two at the top left are painted on thin steatite cylinders housing subminiature tubes. The one top center is printed on the envelope of the 6K4 triode. The second from top right is painted on the envelope of a T-2 subminiature type tube while the circuit at top right is a flat-plate transmitter. The bottom row (left) shows front and back views of a plate transmitter with the completely assembled transmitter at the right. (Right) A self-explanatory photograph of various printed circuit units.




SINGLE TUBE TRANSMITTER FOR 2 METER BAND
SINGLE STAGE AMPLIFIER WITH PHASE SHIFT NETWORK FOLLOWED BY OUTPUT CONTROL STAGE
TWO STAGE AMPLIFIER UNITS

DYNAURAL PREAMPLIFIER Provides Wide Compensation

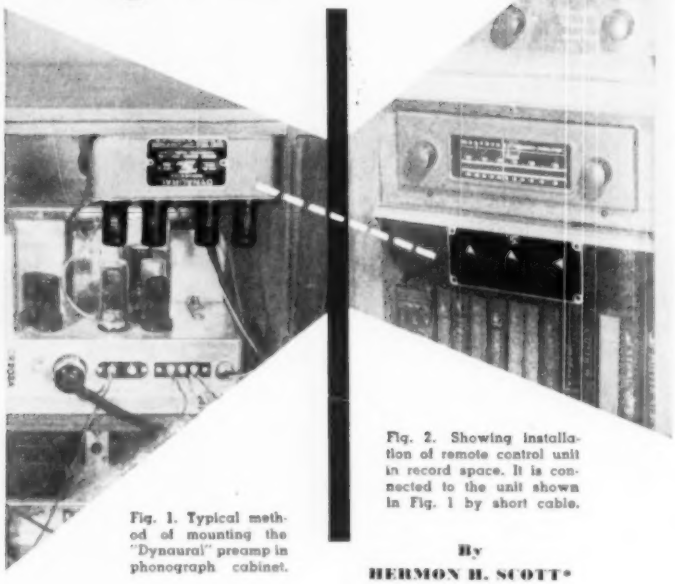


Fig. 1. Typical method of mounting the "Dynaural" preamp in phonograph cabinet.

Fig. 2. Showing installation of remote control unit in record space. It is connected to the unit shown in Fig. 1 by short cable.

By
HERMON H. SCOTT*

A combination preamplifier and dynamic noise suppressor which will improve your phono's performance. It provides the necessary boost for new wide-range magnetic pickups and reduces usual surface noise present on all recordings.

RECENT improvements in recording have produced phonograph discs which rival the range of the human ear. All records, however, have a definite and generally annoying background noise which increases with wear and dust and detracts from the realism of the reproduced performance. With the new, fine-groove techniques the effects of both surface noise and turntable rumble have been aggravated. Also, the new wide-range magnetic pickups are characterized by a very low output level, thus requiring extra amplification or "preamplification."

Many music lovers want to take advantage of all the remarkable post-war phonograph improvements. Irrespective of how good the amplifier and speakers, two fundamental features are necessary to make a phonograph installation really modern. The first is a true "Dynaural" type Dynamic Noise Suppressor to reduce both scratch and rumble without fixed loss of high overtones or deep bass. The second is use of the new wide-range magnetic pickups which are able to reproduce the full range of recorded music. Such a combination is unbeatable on all types of records, shellac or plastic, high or low speed, fine or standard groove.

In "Dynaural" reproduction, the range of the system is constantly and automatically controlled by the music in accordance with the characteristics of the music and the ear so that excess noise, scratch, and rumble are suppressed with little noticeable change in tone quality. This control action is obtained by reactance tube "gate" circuits.[1]

* Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.

Preamp and Bass Compensation

By combining the functions of noise suppression and preamplification in a single integrated circuit, certain economies can be effected, and what is even more important, the over-all performance can be improved. Fig. 3 shows a typical circuit. The preamplifier stages are fairly conventional except for the low-frequency compensation. The 6SC7 tube was chosen because of its low hum level even when operated on a.c. Since both halves of this tube have a common cathode, the only practical bias arrangement is the grid leak type.

In most "Dynaural" circuits, to obtain best operating impedances for the high frequency gate, an L-pad matches the input of the gate circuit to the preceding tube. This naturally introduces some loss. Similarly, bass boost circuits introduce loss depending upon how much the bass must be increased. In this circuit, by inserting the bass boost condensers directly in the impedance matching L-pad, both functions of impedance matching and bass compensation are accomplished with a single circuit with only a single loss.

At high frequencies, where low gate circuit impedance is important, the bass boost condensers have little effect. Consequently, this arrangement does not adversely affect suppressor performance. Similarly, the gate circuits present a comparatively high impedance at low frequencies and do not affect the bass boost. This design effectively eliminates one amplifying stage, and, at the same time, allows the bass compensation to operate at a relatively low impedance and high level—thus precluding difficulties with capacitance and hum pickup, if the leads are extended several feet for remote control of bass turnover.

Turnover Control

The low frequencies in records are attenuated generally at an average rate of 6 db. per octave below some frequency known as the "turnover" point as shown in Fig. 4. In the early electrical recordings the turnover frequency was generally at approximately 250 or 300 cycles per second. Many commercial recordings still have the turnover at this frequency. However, as the recording art progressed there was a tendency to record at louder levels to override noise. Consequently, to avoid overcutting on the bass, the turnover point was raised progressively to as high as 800 or 1000 cycles by some companies while the National Association of Broadcasters standardized on 500 cycles for transcriptions.

To reproduce all recordings prop-

erly with natural bass some adjustment must be possible in the reproducing equipment to shift the effective turnover point below which the bass must be boosted as shown in Fig. 5. If Figs. 4 and 5 are added together for any particular turnover point, the over-all response is obviously flat.

Since most recording characteristics have had average turnovers around 300, 500, and 800 cycles, these values were chosen for the "Dynaural" preamplifier. This further allows all recording bass turnovers, from below 250 to over 1000 cycles, to be matched within about 2 db, which is a generally unnoticeable difference in sound reproduction. Fig. 6 shows the maximum error in frequency response for various recording turnovers between 250 and 1000 cycles.

The Gate Circuits

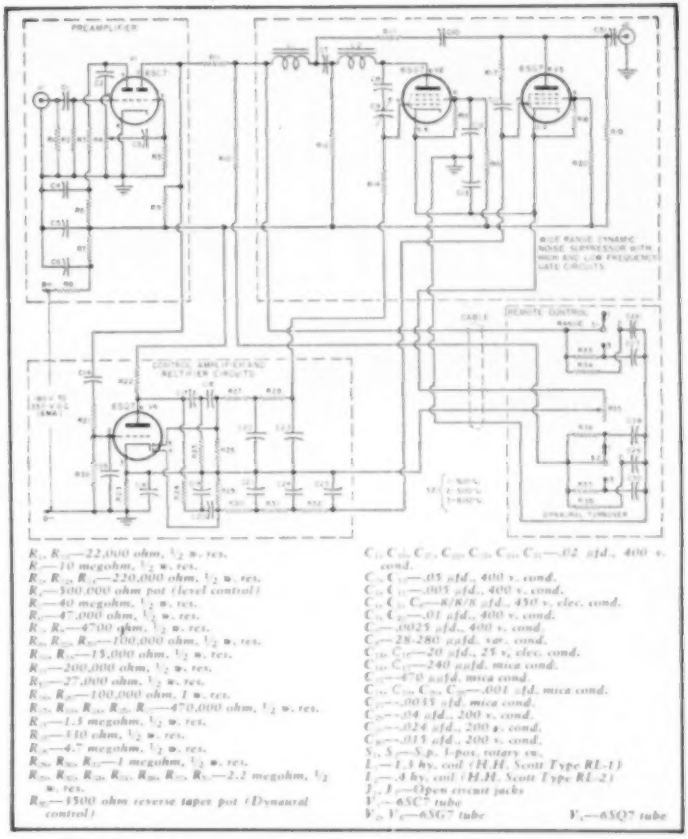
The "Dynaural" gate circuits are the latest wide-range type originally developed particularly for the British Dynamic Noise Suppressor licensee, *Electric and Musical Industries, Ltd.*, manufacturers of *His Master's Voice* and *Columbia* records and a pioneer in extended range recordings.

To provide extended range and also remote control, the circuits operate at a lower impedance than earlier models. This allows the range, as well as the suppression, to be controlled remotely without difficulty due to cable capacitance or hum pickup.

The first 6SG7 tube acts as a variable capacitive reactance, thus controlling the upper limit of the range. The second one simulates a variable inductive reactance, controlling the lower limit. Separate control circuits bias the grids of these tubes in accordance with the signal, thus providing automatic and substantially instantaneous dynamic bandpass action.

The coils are *H. H. Scott* types RL-1 and RL-2, rated at 1.3 and 0.4 henrys. These coils are designed for the correct "Q" over the entire frequency range and use of other types may result in inefficient gate operation.

The "Dynaural" suppression control, as in all of the original Dynamic Noise Suppressors, operates in a d.c. circuit, the leads of which may be extended to any desired length. This control simultaneously adjusts the degree to which the gate circuits may close to decrease the noise bandwidth and the sensitivity of the control action. On reasonably good records this control need be turned only partly on, that is, it should not be operated too close to 0 ohms.



R_1, R_{12}—22,000 ohm, ½ w. res.
R_2—10 megohm, ½ w. res.
R_3, R_{13}, R_{17}—220,000 ohm, ½ w. res.
R_4—500,000 ohm pot (level control)
R_5—40 megohm, ½ w. res.
R_6—47,000 ohm, ½ w. res.
R_7, R_8—4700 ohm, ½ w. res.
R_9, R_{10}, R_{20}—100,000 ohm, ½ w. res.
R_{11}, R_{15}—15,000 ohm, ½ w. res.
R_{14}—200,000 ohm, ½ w. res.
R_{16}—27,000 ohm, ½ w. res.
R_{18}, R_{21}—100,000 ohm, 1 w. res.
$R_{19}, R_{22}, R_{23}, R_{25}$—470,000 ohm, ½ w. res.
R_{24}—1.5 megohm, ½ w. res.
R_{26}—330 ohm, ½ w. res.
R_{27}—4.7 megohm, ½ w. res.
R_{28}, R_{29}, R_{32}—1 megohm, ½ w. res.
$R_{30}, R_{31}, R_{33}, R_{34}, R_{35}, R_{36}$—2.2 megohm, ½ w. res.
R_{37}—4500 ohm reverse taper pot (Dynaural control)

$C_1, C_{10}, C_{17}, C_{20}, C_{21}, C_{31}, C_{32}$—.02 μfd., 400 v. cond.
C_2, C_{11}—.05 μfd., 400 v. cond.
C_3, C_{12}—.005 μfd., 400 v. cond.
C_4, C_{13}, C_{22}—8/8/8 μfd., 450 v. elec. cond.
C_5, C_{23}—.01 μfd., 400 v. cond.
C_6—.0025 μfd., 400 v. cond.
C_7—28-280 μμfd. var. cond.
C_8, C_{24}—20 μfd., 25 v. elec. cond.
C_9, C_{25}—240 μμfd. mica cond.
C_{14}—470 μμfd. mica cond.
$C_{15}, C_{16}, C_{26}, C_{27}$—.001 μfd. mica cond.
C_{18}—.0033 μfd. mica cond.
C_{19}—.04 μfd., 200 v. cond.
C_{28}—.024 μfd., 200 v. cond.
C_{29}—.015 μfd., 200 v. cond.
S_1, S_2—5-p. 1-pos. rotary sw.
L—1.3 hy. coil (*H.H. Scott Type RL-1*)
L—.4 hy. coil (*H.H. Scott Type RL-2*)
J_1, J_2—Open circuit jacks
V_1—6SC7 tube
V_2, V_3—6SG7 tube
V_4—6SQ7 tube

Fig. 3. Schematic shows how the "Dynaural" preamplifier and noise suppressor are combined in a single assembly. Connections for remote control are also indicated.

The factory adjustment of a Dynamic Noise Suppressor is rather complex and involves considerable laboratory equipment. Where factory adjustment is impossible, however, the following procedure will suffice.

The trimmer (C_1) in the grid circuit of the first 6SG7 determines the maximum suppression. With the control (R_{37}) set to 0 ohms and the grid of the 6SQ7 grounded, this trimmer should be set for maximum noise reduction without regard to quality.

The ground should be removed from the grid of the 6SQ7 and the "Dynaural" control (R_{37}) set at some intermediate position, such as 400 ohms. The *level* control (R_4) is normally left fixed and compensates for the sensitivity of different pickups. If the control is set too high the gate circuits may be heard opening on loud passages. If it is set too low the gate circuits will not open enough and a "dead" quality will result. The best setting is that at which all types of records can be played satisfactorily by merely readjusting the "Dynaural" control setting and, if necessary, reducing the setting of the *range* control (S_1) when the signal is distorted.

It is obviously useless to attempt to reproduce frequencies above the range

(*Continued on page* 108)

Fig. 4. Typical low frequency attenuation for various turnover frequencies as used in recording different phonograph discs.

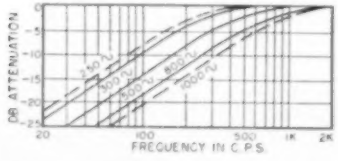


Fig. 5. Theoretical bass compensation required to equalize for 300-, 500-, and 800-cycle turnover frequencies on recordings.

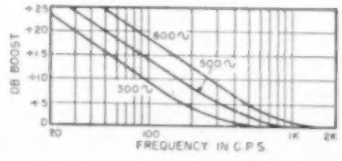
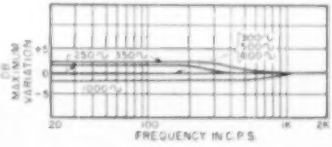


Fig. 6. Max. error in f.f. response resulting from use of 300-, 500-, and 800-cycle equalization for 250-1000 turnover points.



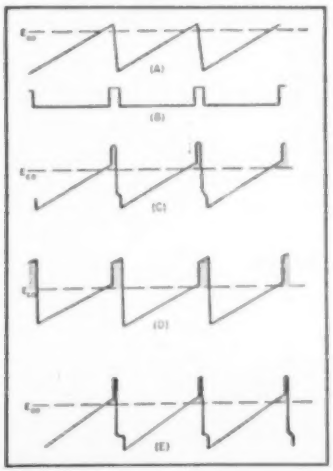
A Single Tube A.F.C. Circuit for TV Deflection Systems

Covering a horizontal deflection oscillator which has been used in television receivers made by RCA. The oscillator incorporates in a single tube a special saw-tooth wave generator of inherently high stability and all the elements of an a.f.c. system.

By
JOHN A. CORNELL
RCA Service Co., Inc.

GOOD noise immunity in the horizontal-deflection circuit of a television receiver practically dictates the use of an automatic frequency control system for the deflection-waveform generator. Such systems generally employ a phase detector which compares the phase of the stripped sync signal with that of the deflection waveform. The output of the phase detector is essentially a direct potential with a level that is a function of the magnitude of the phase difference between the sync signal and the deflection waveform. When this phase difference is altered for any reason, the phase detector translates the change into a proportional change in the level of its output potential. This potential is applied as a frequency-controlling bias to the horizontal oscillator. Any change in the control bias resulting from a shift in the phase relationship between the sync signal and the deflection waveform changes the oscillator frequency in the proper direction to correct the phase shift. Once phase coincidence of the deflection waveform and the sync signal is established, the phase-detector output potential stabilizes at a value required to maintain that coincidence until such time when further correction is required.

Fig. 2. Waveforms of circuit of Fig. 1, showing width modulation of sync pulse.



Good noise immunity is obtained with this type of synchronization by inserting a low-pass filter between the output of the phase detector and the controlled line-frequency generator. The filter averages the effects of random noise pulses while, at the same time, it passes the low-frequency error voltage necessary to maintain a fixed phase relationship between the deflection waveform and the sync signal.

A simple circuit for accomplishing the foregoing action with but a single tube is shown in Fig. 1. This circuit illustrates the principles of the more complex circuit employed in actual receivers. The right-hand triode, V_{1a}, operates as a conventional blocking oscillator and discharge tube. Across C_3 is developed a saw-tooth waveform which is fed to the horizontal deflection amplifier. A sample of this waveform is also fed to the grid of the oscillator control tube, V_{1b}, along with the stripped sync signal of positive polarity. The saw-tooth, the sync, and their resultant combination are illustrated in Figs. 2A, 2B, and 2C, respectively. These waveforms are shown in the time positions they would normally occupy in a synchronized condition. The bias on the control tube is adjusted so that plate conduction, shown shaded in Fig. 2, occurs mainly during the pulse interval.

Notice, in Fig. 2C, that the leading half of the sync pulse rests on the positive slope of the waveform, and the trailing half is down on the sharp negative slope. Only the leading half of the sync pulse is effective in producing plate-current flow in the control tube, since the trailing half occurs beyond cut-off. Plate-current flow charges condenser C_2 to a potential which is a function of the shaded area shown in Fig. 2C. This potential decreases somewhat between sync pulses as a function of the complex time constant in the cathode circuit of the control tube. The net result is that an average positive voltage, which is a function of the charge placed on C_2 during the control-tube conduction time, appears across C_2 and is applied as a bias to the blocking-oscillator grid. This bias, together with the constant parameters of the oscillator circuit, establishes the oscillator frequency at the sync-pulse frequency.

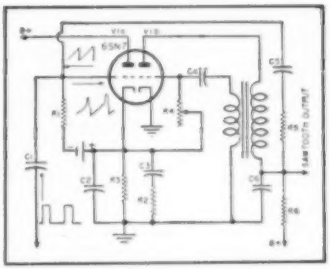


Fig. 1. Simplified a.f.c. oscillator circuit.

If, for any reason, the oscillator should tend to drift toward a lower frequency, the trailing half of the sync pulse would slide up the negative slope of the saw-tooth as shown in Fig. 2D. The shaded area increases under this condition, so that the average potential across C_2 rises. The greater positive bias on the grid of the blocking oscillator increases the oscillator frequency until the proper degree of phase coincidence, as illustrated in Fig. 2C, is again attained. Fig. 2E shows the reduction in average

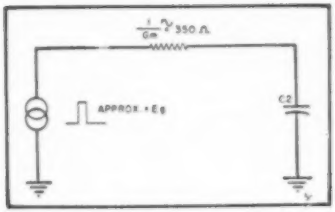


Fig. 3. Showing the equivalent circuit of the control tube during conduction period.

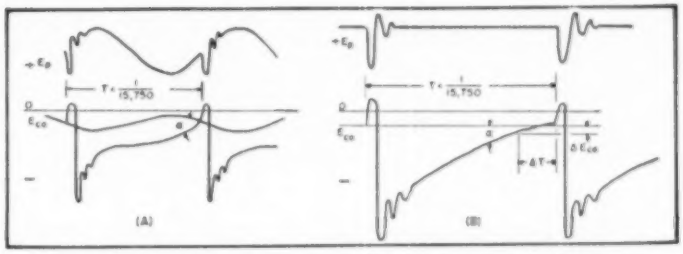


Fig. 4. (A) Grid and plate waveforms of blocking oscillator with sine wave stabilization. (B) Grid and plate waveforms of conventional blocking oscillator.

control-tube current when the oscillator frequency is slightly higher than the sync-pulse frequency.

Several interesting features of the circuit shown in Fig. 1 can now be pointed out. A study of Fig. 2C will show that no extreme differentiation of the stripped sync signal should be required to remove the low-frequency vertical sync components, as is required with some other methods of synchronization, in order to avoid loss of horizontal sync during the vertical sync interval. Since only the leading half of each sync pulse is effective in producing current flow in the control tube under normal conditions, the shaded area shown in Fig. 2C remains essentially constant, regardless of whether the pulse at a particular instant is a horizontal pulse, a vertical pulse, or an equalizing pulse. The trailing edges of the serrated vertical sync pulses may cause a small amount of conduction just before the shaded areas, but in practice this is not objectionable and can be partially compensated for by slightly differentiating the sync signal.

An important consideration of the circuit is that the amplitude of the sync pulse fed to the control tube should remain essentially constant. Since the control voltage developed by the phase detector is a function of the sync-pulse area, this voltage will depend not only on the width of the pulse, but also on the amplitude. If a receiver using a poor sync-separation system and employing this circuit were to be switched from a strong-signal station to a weak-signal station, the lower nominal control voltage developed by the phase detector due to the decrease in sync-pulse amplitude might necessitate resetting the horizontal-hold control. Receivers employing conventional sync separators and limiters of good design will normally keep the amplitude of the stripped sync pulses constant over a wide range of signal strengths.

A fairly critical item of the circuit is the cut-off potential of the control tube, which should remain constant at the value indicated in Figs. 2C, 2D, and 2E. A decrease in cut-off potential would result in lower phase-detector sensitivity and decreased pull-in range, while an increase would cause the control tube to conduct too heavily previous to the sync-pulse interval. This might force the blocking oscillator frequency to increase beyond the hold-in range of the phase detector. Sufficient stabilization of the control-tube bias at the proper value, despite the wide variations in line voltage that might occur in normal use, can be obtained by deriving the control-tube bias from the grid-leak voltage of the blocking oscillator. A potentiometer can be used to vary the control-tube plate voltage and, consequently, the cut-off voltage over a small range. This potentiometer, which replaces the usual horizontal-hold control found on other receivers, is, in effect, a vernier frequency control which takes care of extreme line-voltage variations and aging of tube and components.

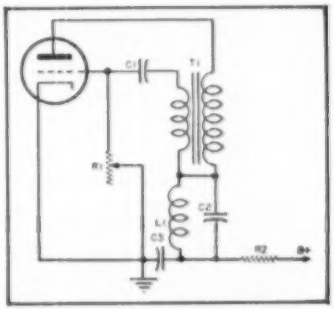
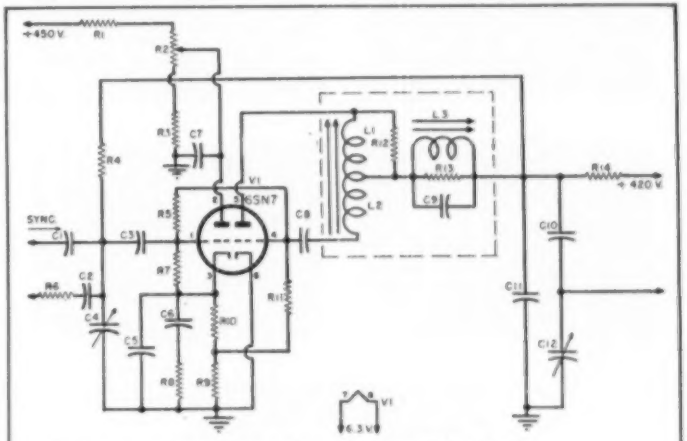


Fig. 5. Showing circuit diagram of blocking oscillator with sine wave stabilization.

The components in the cathode circuit of the control tube are chosen to obtain maximum phase sensitivity consistent with over-all stability and optimum noise immunity. An equivalent circuit of the control tube during the time it is conducting is shown in Fig. 3. Resistance R_c and the series combination of R_k and C_k have been neglected, since their impedances are large compared to the internal impedance of the control tube. The internal impedance of a triode operated in the circuit of Fig. 1 during the conduction

Fig. 6. Combined a.f.c. circuit and blocking oscillator with sine wave stabilization.



R_1, R_2, R_{13}—150,000 ohm, ½ w. res.
R_3—50,000 ohm pot.
R_4—82,000 ohm, ½ w. res.
R_5—2.7 megohm, ½ w. res.
R_6—560,000 ohm, ½ w. res.
R_7—820,000 ohm, ½ w. res.
R_8, R_{11}—8200 ohm, ½ w. res.
R_9, R_{14}—100,000 ohm, ½ w. res.
R_{10}—22,000 ohm, ½ w. res.
C_1, C_2—180 μμfd. mica cond.
C_3—5 μμfd. ceramic cond.
C_4, C_5—.0022 μfd. mica cond.
C_6—10-160 μμfd. var. cond.
C_7—.022 μfd. @ 400 v. cond.
C_8—.22 μfd. @ 400 v. cond.
C_9—.047 μfd. @ 400 v. cond.
C_{10}—.01 μfd. @ 400 v. cond.
C_{11}—360 μμfd. mica cond.
C_{12}—4-170 μμfd. var. cond.
L_1, L_2, L_3—Powdered iron core coils in blocking oscillator assembly
V_1—6SN7 tube

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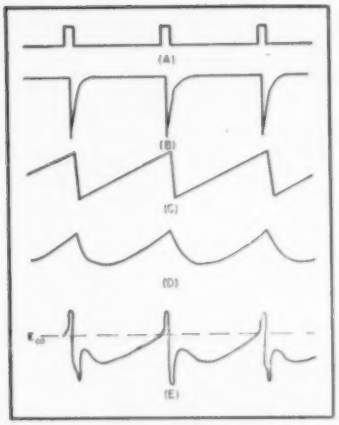


Fig. 7. Waveforms of the circuit given in Fig. 6, showing the synthesis of the waveform applied to the control-tube grid.

interval is approximately $1/G_m$. For a 6SN7, this is about 350 ohms. The equivalent generator of Fig. 3 delivers a pulse almost equal in amplitude to the peak value of the sync pulse applied to the control-tube grid. This pulse can have a duration of anywhere from the standard sync-pulse width of five microseconds to practically zero, depending upon the phase shift between the sync signal and the deflection waveform.

In order to make the average voltage across C_1 a linear function of phase shift, the RC charging curve should be linear for the full sync-pulse duration of five microseconds. If the time constant of the equivalent circuit of Fig. 3 is made equal to about 150% of five microseconds, the curve will be sufficiently linear for the first five microseconds. This gives a time constant of 7.5 microseconds; consequently, the value of C_2 should be about .021 mfd. A smaller value will result in lower phase-detector sensitivity; a larger value will slow down the control action and tend to cause hunting.

The value of R_3 is chosen to prevent hunting of the oscillator frequency after a high acceleration of the error voltage across C_2. This might occur, for instance, when the receiver is switched from one channel to another or after any disturbance in the signal. A properly chosen value of R_3 will add a derivative of the error voltage to the initial error voltage applied to the oscillator grid, thus decreasing the delay in the system to a value below that necessary to produce transient or sustained oscillations. Condenser C_3 is made about ten times the value of C_1 so as not to interfere with the error-rate function of C_2 and R_3. The other element of the network, R_4, should be made high in value so that the original error voltage, which eventually appears across C_3, will also be applied to the oscillator grid along with the error-rate voltage.

Blocking Oscillator with Sine-Wave Stabilization

An extremely stable blocking oscillator can be produced if a sine wave is used to stabilize the blocking period. To illustrate the principle of sine-wave stabilization, a curve representing the grid-voltage waveform of a conventional blocking oscillator is shown in Fig. 4B. The nearly asymptotic approach of the positive slope of the grid waveform to the tube cut-off potential is the primary reason for the inherent poor stability of such oscillators. A small change in cut-off potential due to a line-voltage variation, or to a small change in the positive slope of the grid waveform resulting from thermal drift of the components, would result in a considerable change in the period.

A rough measure of the oscillator stability is the ratio of $\triangle E_{co}$ to $\triangle T$, or tan α, as shown in Fig. 4B. The stability of a blocking oscillator can be measurably improved if the angle α is made larger. A circuit which accomplishes the increase in α, with an attendant improvement in stability, is shown in Fig. 5. This circuit can be recognized as a blocking oscillator with the addition of a parallel LC circuit inserted in the plate supply line. This circuit, L_1C_1, is tuned somewhat higher than the natural frequency of the blocking oscillator. When the tube conducts, C_1 discharges through the tuned circuit, the plate winding of the transformer, and the tube. The discharge current shocks the tuned circuit into oscillation, and the ensuing sine-wave voltage across L_1C_1 is applied to the grid and the plate of the tube in phase. (Continued on page 144)

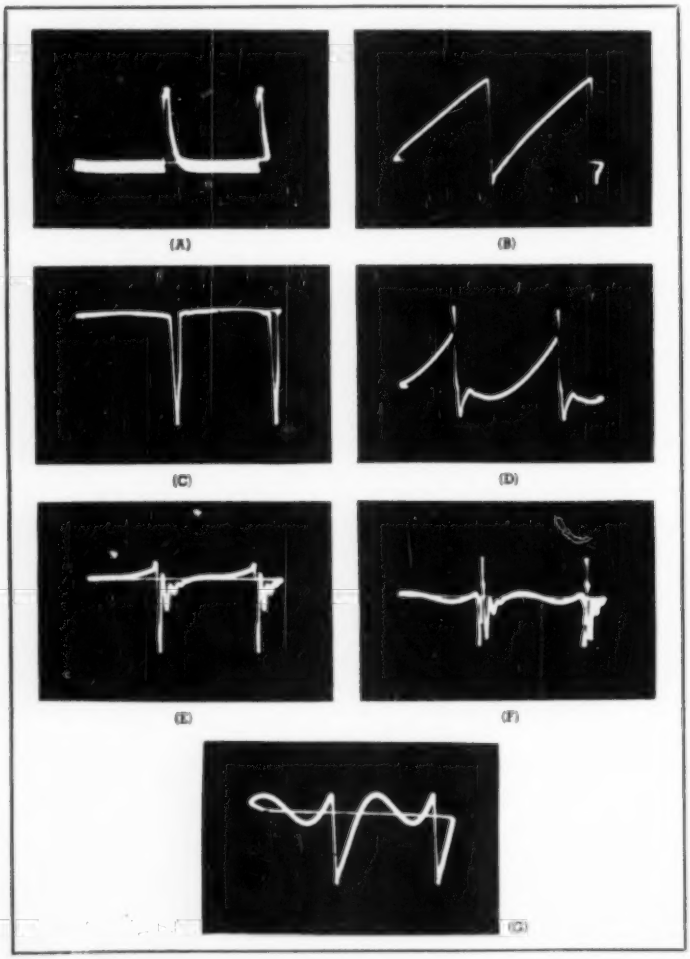
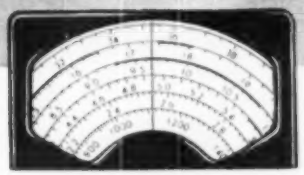


Fig. 8. Waveform photographs of the circuit shown in Fig. 6. (A) Horizontal sync signal applied to left terminal of C_1. (B) Saw-tooth output across C_1. (C) Voltage across horizontal deflection coils applied to left terminal of R_1. (D) Composite signal on control tube grid. (E) Oscillator grid voltage. (F) Oscillator plate voltage. (G) Saw-tooth wave plus sine wave at the junction of coils L_1, L_2, and L_3.

International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

THIS month's club news includes items of interest regarding two clubs in the United States.

United States—The *Newark News Radio Club* has announced that Henry (Hank) and Amelia Bennett, 302 Laurel Avenue, Woodlynne, New Jersey, have been appointed short-wave editors of that organization.

A *new* club is the *United 49-ers Radio Society;* officers include Ed Broome, president; Jim Zaloudek, vice-president; Anna Carson, secretary; Dan Ainsworth, treasurer; Charles McCormick, chaplain; Bill Peters, editor, and Walt Carson, assistant editor. Both SWL's and hams are welcomed. QRA is Dan Ainsworth, 62 Dickinson Street, Binghamton, New York. (Boice, Conn.)

This Month's Schedules

Alaska—Fox, New Zealand, has received verification from a Coast Guard station in Alaska which *asks for reports from distant listeners;* it is NMJ, 2.698, with voice broadcasts daily of marine information, including weather report, at 0100, 1300; power 3 kw. into antenna. (Radio Australia)

Albania—*Radio Shkodra*, 8.220, Skutari, has extended its schedule to weekdays 1200-1600, Sundays 1100-1600.

Angola—Experimental transmissions have taken place from Radio Clube de Louanda at Nova Lisboa; transmitter operates in the 25-m. band and was heard at 1545; announcements in Portuguese and French; reports requested to P.O. Box 125, Nova Lisboa, Angola; transmitter directed to Belgian Congo and Fr. Equatorial Africa. A later report lists frequency as 11.925. (Radio Sweden) Gillett, South Australia, is hearing Angola on 7.140 in parallel with CR7RN, 9.470, until closing 1600 with "A Portugesa"; callsign on 7.140 is unknown, he says. (CR6RN, Luanda, "Radio Clube de Angola," is listed 7.130V with 1 kw.—KRB.) Gillett hears CR6RG, 8.242, from opening a few minutes after 1330, good signal.

Arabia—Bluman, Israel, reports Mecca some time ago was broadcasting on 11.950, 5.98, 3.975 at 1200-1300; programs included readings from the Koran, prayers, and news for pilgrims (presumably all-Arabic); says transmitters actually are commercial phone stations at Djedda. This was for a special religious festival season—but may be heard later on occasion.

Argentina—LRY, 9.455, Buenos Aires, now has a "pen-pal" session Sundays 2130, called "International Mail." QRA given as Box 1841. (Leary, Ind.) LRM, 6.18, Mendoza, opens 0500 with music, then has news in Spanish. (Sanderson, Australia) LRT, Tecuman, seems to have settled down on 11.84, opens 0500. (Cushen, N.Z.) Operates daily in Spanish 0700-1200, 1600-2100. (Radio Sweden) LRT is good level in New Zealand around 2000 (Collett)

Australia—VLX, 4.897, Perth, noted 0515 with music, then news. (Sanderson, Australia) I have been hearing this ABC outlet in West Virginia best around 0630-0730. Sanderson reports VLM, 4.917, *new* Brisbane outlet, 0430 with news, music.

Austria—Simpson, Australia, reports Blue Danube Network, Salzburg, is now heard on 9.480 from around 0145. (Radio Australia) Is listed 9.535. Pearce, England, reports this one on 9.494 at 0100 with "Rise and Shine," recordings; sports 0110; 15 minutes of world news 0115; also heard later around 0900. Heard in Alabama by Hagen around 0000-0100. Brownless, England, says has program details around 1155 and appears to close 1900.

Azores—Patrick, England, says Ponta Delgada, 4.845, is fine level around 1700. Alcock, Ky., reports the 11.090 channel is good 1500-1600 but has severe CWQRM. Pearce, England, lists winter schedule of 1500-1600 on 11.090, 1700-1900 on 4.845.

Balearic Islands—*Radio Menorca*, Mahon, moved back to 7.54 from 7.495; heard 1330-1530. (Pearce, England)

Belgian Congo—Bluman, Israel, lists OQ2RC, 6.010, Leopoldville, 250 watts, at 1200-1330.

OTC, 9.757, 50 kw., sent schedule of 1300-1400 and 1400-1415 in Dutch; 1415-1430 French; 1430-1530 *English* (news 1432, headlines 1527); 1530-1645, 1645-1845 French and Dutch; 1900-2030, 2030-2045 French; 2045-2100 Dutch; 2100-2300 *English* for US-Canada (news 2102, headlines 2255). (Hedrick, W. Va.)

Belgium—M. Swaenepoel, head of the Foreign Relations Service of INR, writes Worris, N. Y., that "there are plans for an extensive international broadcasting service from Belgium, which will probably start in 1952. It is as yet impossible to say which frequencies will be used, this will be decided by international agreement. Broadcasts will be directed principally to the Belgian Congo. In addition, there will be programs—as there are now—for France and Empire, Great Britain and Empire, Holland, South Africa, USA, and Canada. There will be *new* programs for South America and for Europe in general. OTC, Leopoldville, will relay so that you will always be able to hear this station. Broadcasts will be in French, Dutch,

(*Continued on page* 115)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given.

This group recently attended the convention of the International Short-Wave Club held at "Chez Auguste" in London, England. The ISWC, which was founded in the United States, has just celebrated its 20th anniversary. Pictured left to right at the speaker's table are T. E. Port, winner of the ISWC's DX Contest No. 2; J. E. Allrey, F. C. Speller, and W. J. Wilson (chairman), judges in the Contest; Arthur E. Bear, Hon. Secretary of ISWC; William Olason, of the British Broadcasting Corporation; and Patricia Board, ladies' representative of the International Short-Wave Club.

A Versatile, Low-Power TRANSMITTER

Front and rear views of the compact transmitter with its self-contained power supply.

By
G. L. COUNTRYMAN,*
W3BHR, W1RBK

An efficient oscillator plus fixed bias on the final permits chirp-free keying.

CAREFUL consideration should be given to the little unit to be described herein. A newcomer to amateur radio can build it, knowing that it will never be discarded when he goes to high power; the more advanced ham may construct it for his multiplier and driver stage, and the experimenter will find it invaluable for testing out different v.f.o.'s, various driver and amplifier circuits, etc. Its small, compact size makes it especially desirable. It can be used, as is, on the operating table, or it can be mounted on less than half of a standard 8¾" x 19" rack panel. The latter procedure requires cutting a minimum number of holes in the rack panel. Obviously, if the unit is to be mounted on a rack panel, the 8¾" x 7⅛" panel shown in the photographs should be removed.

By itself, this unit is a full-fledged, 50 watt transmitter, crystal controlled and completely self-contained including the power supply. The amplifier is biased to cut-off which keeps the 807 tube on an even keel. The output is a link coil connected to a coaxial jack so that the rig can feed directly into a center-fed dipole or folded dipole, or to the grids of one or two high-power final amplifier tubes. Controls have been kept to a minimum. The first stage is broadband and requires no tuning over any one amateur band. In fact, the only adjustable control on the rig is the 807 plate tank tuning control. Omission of a dial scale for this control was deliberate to preclude adjustment to a predetermined setting which may or may not be correct, rather than to the setting which results in a dip in the plate current.

The key jack is located on the rear chassis apron along with a *Millen* ¾" crystal socket, the output coaxial jack and an input coaxial jack paralleling the crystal socket. A *Mosley* adaptor is used when it is desired to plug ½" spacing crystal holders into the crystal socket. The ¾" socket was selected as the single bolt provided a good mounting for the 6AG7 grid r.f. choke (*RFC*, Fig. 1). The cone insulator furnished with this choke is reversed as the small end will fit between the crystal prongs. This r.f. choke is a "must" for dependable operation if both crystal and v.f.o. drive are contemplated. The spacing between the crystal socket and the input coaxial jack is sufficient to permit the use of crystals in the large round holders if desired.

By removing the crystal from its socket and connecting a coaxial cable to the input jack, a v.f.o. may be used to drive the transmitter in lieu of the crystal. With a simple one-tube *Clapp* circuit v.f.o., using a 6C4 tube connected to the input, the 6AG7 not only serves as an excellent broadband isolation tube and amplifier, but will also function as a doubler, tripler, or quadrupler. As the 807 may be used either as an amplifier or as a doubler, the little rig is extremely versatile as far as its frequency range is concerned.

The key jack is a closed-circuit type. Thus, when the phone plug connecting the key is removed, the cathode circuits of the tubes are closed, permitting v.f.o. keying to be used as the 807 is biased to cut-off. On the other hand the v.f.o. may be allowed to run continuously, and the two stages in the transmitter may be keyed simultaneously by merely inserting the key plug in this unit. Be sure that a plug is in the key jack when testing.

The chassis is a standard 7" x 12" x 3" and should be fairly husky with the sides folded in. *Bud* brackets are used rather than *Parmetal* as the *Bud* type are cut out, permitting the chassis to fit flush against a panel. The high voltage winding of the power transformer furnishes 500 volts at 100 mils to the 807 tube when loaded. A 65 volt bias tap is provided, and the bias voltage is rectified by a 100 mil selenium rectifier. The 4 μfd., 600 volt oil condensers are a surplus item at about fifty cents each. The 150 mil choke has plenty of iron in its core and also came from the surplus store as did the milliammeter. Either an 83 or 523 rectifier tube may be used.

All component values shown were determined experimentally and, as is frequently the case, are not always those recommended by the manufacturer, nor are they necessarily the values derived when you sit down with a pencil and paper to figure out exactly what value some component should have. No resistor was found necessary across the iron core coil form used in the plate circuit of the 6AG7 for broadbanding this stage. Even without a resistor good response is obtained across any one amateur band, and the trimmer condenser and core adjustments are not critical. In

* Comdr. U.S.N., Electronics Officer, Boston Naval Shipyard.

winding the *Millen* coil forms, the directions on the data sheet accompanying each form may be followed. Using the coil data set forth in Fig. 1, the ceramic trimmer should be set at about mid-value and the core adjusted for maximum output on each ham band for which coils are wound. The core adjustment will be about half way within the winding. This method eliminates the necessity for changing the setting of the trimmer condenser when changing coils. No bleeder is used across the selenium rectifier to ground. With a bleeder in the circuit the effect was to ground the approximate center of the high-voltage winding of the transformer as well as the exact electrical center, and some weird results were forthcoming! Several different kinds of electrolytic condensers were tried for the filter following the selenium rectifier. None was satisfactory. A good old surplus "bathtub" condenser was placed in the circuit and functioned perfectly. The selenium rectifier is mounted vertically on the side of the chassis, underneath, for good heat dissipation.

With bias on the 807 and the small resistors in the control grid and screen grid leads of the 6AG7 it is impossible to make the rig behave in other than a normal manner. It is virtually "bug-proof" and works along day after day as steady as a rock. Incidentally, when mounting these grid resistors, the pig-tail leads should be clipped off as short as possible and the resistor mounted directly at the socket terminals. The cathode resistor should be 56 ohms. A substantially higher value will be unsatisfactory.

For crystal operation, two bands may be used with one crystal provided the harmonic relationship is correct, as the 807 delivers as much output when doubling as it does when amplifying straight-through. This means that output on both 20 meters and 10 meters can be obtained with a 20-meter crystal of the fundamental type. Crystal current is low and barely lights a 60 mil pilot bulb. The 807 can be amplitude modulated with equal effectiveness when being used as a straight amplifier or as a doubler, although the latter is not in accordance with good engineering practice.

No particular constructional difficulties should be experienced. It is recommended that the panel meter hole not be cut until the unit is completely assembled. There is not too much clearance between the filter condensers and the choke, and the meter must be accurately located. Fasten the meter to the panel before attaching the panel, as the holes for the bolts holding the meter are nearly inaccessible after the panel is in place. The use of lock washers with every nut and bolt will pay dividends in reliability and stability. Don't forget to ground the shell of the 6AG7 (terminal 3).

The *Bud* coils are inexpensive and are very satisfactory. The combination of a *Millen* socket and *Bud* coil keeps the coil winding well above the metal chassis. The fixed link on the 40-meter coil did not give sufficient energy transfer so it was removed, and a link made of three turns of pushback wire was wound directly over the windings at the cold end of the coil.

If it is planned to operate this unit as a transmitter using the convenient twin lead folded dipole antenna, it is easy to attach the 300 ohm twin-lead feeder to a coaxial connector. The fact that one side of the coaxial socket or jack is grounded to the chassis made no operational difference when compared to a connection with the twin-lead going directly to the pickup coil.

The unit including its power supply occupies about the same space as the popular "command" series of transmitters and can be constructed as readily as a "command" transmitter can be modified.

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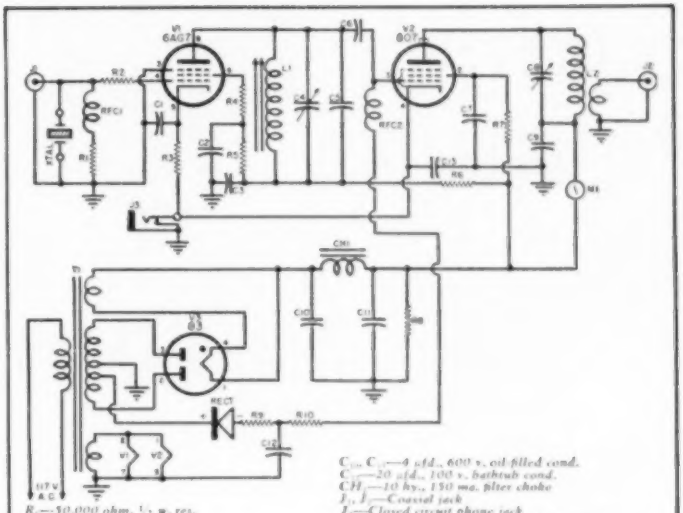
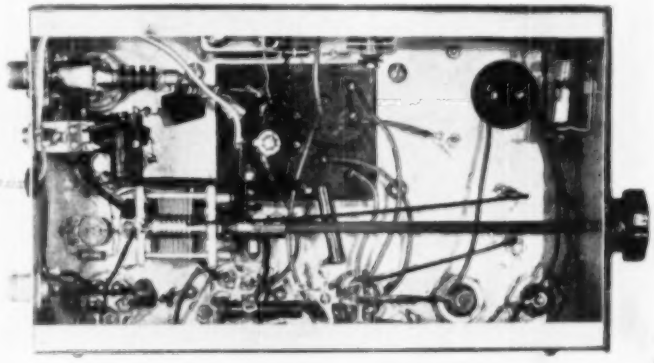

V1 6AG7
V2 807
V3 83
RECT
CH1
J1
J2
M1
117 V A.C.
R_1—50,000 ohm, ½ w. res.
R_2, R_3—47 ohm, ½ w. res.
R_4—56 ohm, ½ w. res.
R_5—15,000 ohm, 2 w. res.
R_6—10,000 ohm, 10 w. wirewound res.
R_7—17,000 ohm, 10 w. wirewound res.
R_8—100,000 ohm, 5 w. wirewound res.
R_9—100 ohm, 1 w. res.
R_{10}—2000 ohm, 2 w. res.
C_1, C_3, C_4, C_9, C_{15}—.01 μfd., 600 v. cond.
C_2—.001 μfd., 600 v. cond.
C_5—6 to 30 μμfd. trimmer cond.
C_6—50 μμfd. Ceramicon cond.
C_7—100 μμfd. mica cond.
C_8—75 μμfd. midget var. cond (Bud CE2003)
C_{10}, C_{11}—4 μfd., 600 v. oil filled cond.
C_{12}—20 μfd., 100 v. bathtub cond.
CH—10 hy., 150 ma. filter choke
J1, J2—Coaxial jack
J3—Closed circuit phone jack
L1—Closewound on Millen 74001 forms: 80 meter—40 t. @ 32 cm.; 40 meter—30 t. @ 22 cm.; 20 meter—12 t. @ 18 cm.
L2—Bud OEL series (See text)
M1—0-200 d.c. milliammeter
RFC1—2.5 mhy. r.f. choke with standoff (Millen 34100)
RFC2—2.5 mhy. r.f. choke (Millen 34101)
Rect.—100 mil selenium rect.
T1—Power trans. 450-0-450 v. @ 125 ma. with a 63 v. bias tap, 6.3 v. @ 3 amp., 5 v. @ 3 amp.
Xtal—(See text)
V1—6AG7 tube
V2—807 tube
V3—6A6 tube
V4—83 tube

Fig. 1. The transmitter schematic. A selenium rectifier furnishes bias for the final.

Fig. 2. Under-chassis view. An extension shaft is used on the final tank condenser.



Improving Performance Of Small P.A. Amplifiers

By
JOHN B. LEDBETTER
Eng., Station WKRC-TV

These simple circuit changes and additions will go a long way toward improving p.a. performance.

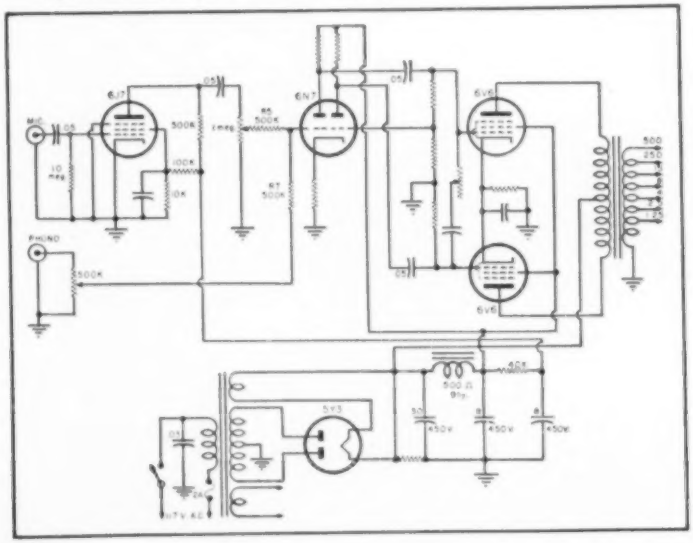
THE service technician engaged in maintenance of p.a. equipment is often confronted with small, low-power amplifier systems whose performance and output could be increased to a worthwhile degree. In some of these amplifiers, this would mean simply replacing a tube, increasing voltages, adding a tone or gain control, etc., while in others a major circuit change, such as adding an extra stage of amplification, installing a limiter circuit, replacing the speaker system, etc. would be advantageous.

Basic Considerations

In most small or medium-power amplifiers, there are a number of changes which can be made to improve performance and flexibility.

Some of these are (1) an increase in amplifier output, (2) improvement in frequency response, (3) reduction of noise and distortion, (4) addition of extra microphone or phonograph stages, (5) variable-frequency filters or equalizers, and (6) the installation of remote controls or extra speaker units. Before modifications or circuit changes are made, however, the limitations of the individual amplifier must be determined. Some models, for example, allow very little margin or safety factor in the design of power and output transformers. Obviously, it is unwise to replace the output tubes with types delivering greater power if the power transformer will not stand the extra filament or plate current drain, or if the output transformer is not capable of handling the added power output without distortion or overloading. The economical factor, or cost of making individual changes or circuit modifications must also be considered.

Fig. 1. Schematic diagram of the Bell Model 510 before circuit changes were made.



Bell 510 Modifications

A good example of a small amplifier which lends itself well to circuit modifications is the *Bell* Model 510. This model, first released in 1939, is still very popular and can be found in relatively large numbers. The tube lineup in this particular model consisted of a 6J7 preamplifier, a 6N7 phase inverter, and two 6V6 output tubes connected in push-pull Class AB1. The output was approximately 14 watts maximum. (Later models used a 6SJ7 and 6SN7.)

The following circuit changes are mentioned in detail, since a comparatively large number of these amplifiers are still in service, and since the majority of changes are equally applicable to other similar amplifiers.

In the Model 510 the output can be increased by replacing the 6V6 tubes with two 6L6's. Since two 6L6 tubes in Class AB1 will give about 18.5 watts output (as compared with 14 watts for two 6V6 tubes under identical conditions) this change may be considered worthwhile. The filament winding of the power transformer is capable of providing the extra ampere of current drain. No circuit changes are necessary either in the bias circuit or in obtaining a proper impedance match. The cathode bias for the 6V6's and 6L6's is very similar; the plate load resistance of the latter is 9000 ohms as compared with 8000 ohms for the 6V6 tubes. The power-handling capabilities of the output transformer are such that the additional power output is carried without appreciable increase in distortion or transformer saturation.

Added drive for the output stage and additional amplification for both the microphone and phono inputs can be obtained by adding an extra stage of amplification. The power transformer can also supply the extra filament and plate current for this stage. In the Model 510, a dry can-type 8 μfd., 450 volt electrolytic filter condenser is used. Since the mounting hole for this unit already has been cut to accommodate a standard octal tube socket,

the installation of an extra stage is greatly facilitated. The condenser can be removed and replaced with a tubular 8 μfd., 450 volt filter condenser, which can be mounted near the rectifier socket. Although *any* desired type of tube may be used, it is recommended that a twin-triode type such as the 6SC7, 6SN7, or 6SL7 be employed so that isolated, individual inputs can be provided for the microphone and phonograph. The tube used by the author in a similar modification some time ago was a 6Z7. At that time, a number of these tubes were available, and tests proved their superiority in several ways over other types then available both in gain and circuit stability.

Parts required for the addition of this stage are an octal tube socket, .05 μfd., 600 volt coupling condenser (C_1), a 1000 ohm, 1 watt cathode resistor, a 15 μfd., 25 volt electrolytic condenser, and a 100,000 ohm, 1 watt plate load resistor. Circuit changes and modifications can be seen by comparing the original schematic (Fig. 1) with the modified circuit shown in Fig. 3. In Fig. 1, both the microphone preamplifier and the phono input circuit were connected to a common grid in the 6N7 stage through series limiting resistors R_5 and R_{11}. These resistors were removed and the individual microphone and phono gain controls fed into separate grids. This affords complete isolation between the two input circuits and allows much smoother operation.

To carry modifications a bit further, the 6J7 preamplifier can be replaced with a 6SJ7. This requires very little change in wiring and allows a much shorter grid lead, with a subsequent reduction in hum pickup. Improved results can be obtained by replacing the 10 megohm grid resistor with a 2 megohm, 1 watt resistor in series with a single 1 volt bias cell. Excellent quality and performance, considering the straightforward circuit design, can be obtained with this amplifier, and the 4.5 watts or so increase in output power will make the unit more valuable as a rental for small and medium-size p.a. jobs.

The flexibility and frequency response of the 510 and similar amplifiers may be increased still more by the addition of a continuously-variable bass and treble boost circuit. In this instance, the original microphone and phono input circuits can be left connected as shown (Fig. 1), and the 6Z7 stage wired as indicated in Fig. 2A. The treble control (R_1) and bass control (R_2) may be mounted on the front panel, preferably above and at either side of the phono gain control. With this circuit, a boost of from 12 to 15 db. can be obtained on both low- and high-frequency response. The regular tone control in the amplifier can still be used to attenuate the higher frequencies to any desired degree. Other tubes, such as the 6SC7, 6SL7, 6SN7, etc. can be used with equally good results.

In certain installations, a volume

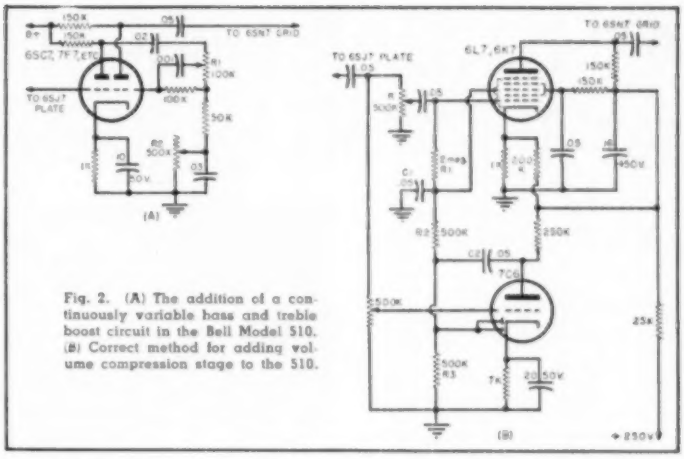


Fig. 2. (A) The addition of a continuously variable bass and treble boost circuit in the Bell Model 510. (B) Correct method for adding volume compression stage to the 510.

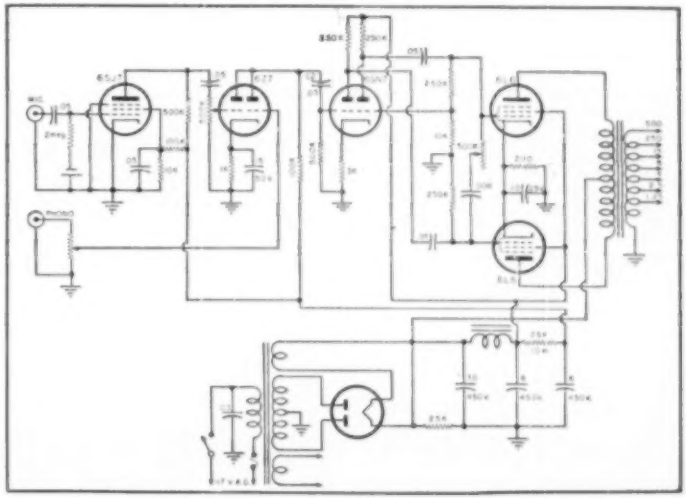
compression stage may be more desirable or useful than either of the two modifications previously mentioned. Again taking the *Bell* Model 510 as a specific example, the 6L7 limiter tube (see Fig. 2B) can be installed in the space originally taken by the filter condenser. In this particular limiting circuit, an extra tube (7C6) is used as a combination bias amplifier and rectifier. Space for this tube and the compression volume control can be found at the rear of the chassis, with the 7C6 mounted horizontally. For individual applications, a slower or faster attack time may be desired. This may be arranged by changing the values of C_1 and C_2 and R_1, R_2, and R_3. The 7C6 cathode bias resistor may also be changed. Try different combinations, changing the values of each component about 20 per-cent each time. For proper adjustment of the limiter circuit as shown, the microphone gain control should be set to give the desired output and the compressor control (R) advanced until the amplifier output begins to cut-off sharply on peaks. The proper limiting or compression level is just below this point. With R adjusted correctly, it should be possible to obtain an average increase of approximately 6 db. in amplifier output. This should prove especially beneficial in noisy or outdoor installations. Precautions should always be taken to avoid over-compression, since this produces drastic reduction in amplifier output, along with excessive distortion. Smoother compression in some cases will be obtained by using a sharper cut-off pentode such as the 6K7 instead of a 6L7.

Silvertone Model 12860

The tube complement in *Silvertone* Models 12860, 12861, and 12862 public

(*Continued on page* 119)

Fig. 3. Modified circuit of the Bell Model 510 public address amplifier unit.



OSCILLATOR and GAIN SET for AUDIO MEASUREMENTS

By
HAL BUMBAUGH, W6HI

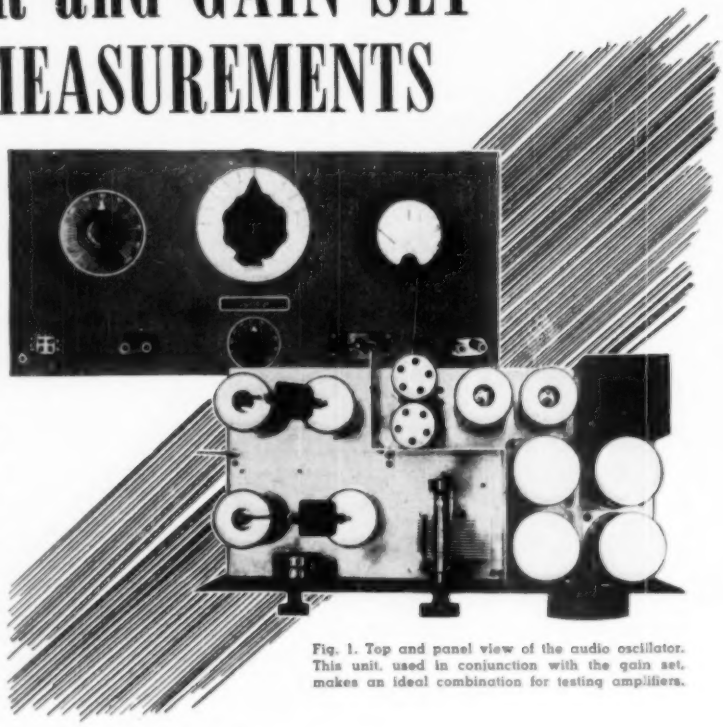


Fig. 1. Top and panel view of the audio oscillator. This unit, used in conjunction with the gain set, makes an ideal combination for testing amplifiers.

Two useful pieces of test equipment for the service technician, experimenter, or amateur radio operator.

IN GENERAL the service technician, amateur, or experimenter is not concerned with such things as phase shift and intermodulation as they pertain to audio equipment nor is he generally in a position to make such measurements but he is, or should be, vitally interested in the over-all response of any audio amplifier or other allied equipment since such a response curve gives a fundamental concept of what can be expected of that equipment. Such a curve also will show where and to what degree correction must be applied to get certain wanted effects. In addition, the response curves of such auxiliary equipment for the audio circuit as filters, equalizers, attenuators, and tone control circuits should be known. All this information can be easily obtained with the equipment to be described.

The first requirement is a good audio oscillator. Of the many audio oscillators available the beat frequency type is one of the better ones and is the type to be described. This type oscillator has excellent waveform and the one to be described has a frequency range which covers the range of normal human hearing.

The oscillator is shown in the photograph of Fig. 1. In this view the components appearing on the front panel are, from left to right, pin jack for ground connection, power plug receptacle, 500 ohm line input, tuning dial vernier knob, "Send-Receive" key for switching the volume indicator, and 500 ohm line output. On the top row, left to right, are the output control knob, main tuning dial, and volume indicator meter, or *VI*. The case measures 15" x 8" x 8" deep.

Fig. 2 is the wiring diagram of the oscillator. As will be seen there are two oscillatory circuits, one relatively fixed in frequency, and one variable. The beat frequency (in the audio range) developed between the output of the two oscillators is dependent on the setting of the tuning condenser of the variable oscillator (and to a degree on the setting of the vernier tuning condenser on the "fixed" oscillator as will be explained under calibration.) It is this frequency that is used in audio measurements.

This audio frequency beat developed between the two oscillating circuits is fed to an intermediate or combining amplifier then to a push-pull output stage whose output, in turn, is fed through a high-quality transformer to the 500 ohm output terminals of the oscillator.

Several of the components should be of the highest obtainable quality. They are, first, the main tuning condenser which should be of the straight-line frequency type having a maximum capacity of 350 $\mu\mu$fd. and the lowest possible minimum capacity. For this purpose we used a *National* girder frame type whose curve of capacity followed very closely that of the condenser used in the *Western Electric* 4-A gain set.

Secondly the padding condensers (fixed) across the tuned circuits of the oscillators should be of the highest quality. We used *General Radio* Type 505-G in the 2000 $\mu\mu$fd. size.

Two coils of 200 microhenrys inductance each will be required. One is to have but one winding with a center tap (for the "fixed" oscillator) and the other a similar winding with the addition of a secondary wound over the first at the center of the coil. This secondary winding should also be center tapped. The coils should have shield cans of a diameter at least twice the diameter of the coil form and should have provision for bringing out the necessary terminals, three in the case of the first coil and six for the second coil. We had a local coil concern wind these up for us and equip them with shield cans. The price was nominal considering the excellent workmanship.

For those who desire to wind their own coils a form 1 inch in diameter and at least 2 inches long is recommended. The desired 200 microhenrys for L_1 and L_2 can be obtained by winding 122 turns of #29 enamel wire close-wound and tapped at the 61st turn over the middle $1\frac{1}{2}$ inches of the coil form length. This will give $\frac{1}{4}$ inch on the form at each end for terminals and mounting brackets. The coils should be mounted in shield cans having a diameter of about 3 inches and sufficient length to allow at least 1 inch clearance between the top of the coil form and the can and the same distance between the bottom of the coil form and the bottom of the can, or face of the chassis.

The coil L_3 consists of 20 turns of #29 enamel wire, center tapped, and wound over the center of L_2.

The circuit is not complicated and there are no bugs to remove after completion if reasonable care is taken in the layout and wiring.

Placement of the various parts, as well as the shielding employed, is shown in Fig. 1. The components are, top row, left to right, tube and coil for the first or "fixed" frequency oscillator, next the two tubes of the intermediate or combining amplifier; the two tubes of the push-pull output stage, and the output transformer.

In the lower row at the left are the tube and coil for the variable oscillator. The four shield cans at the right end house the 250 millihenry chokes and their associated condensers which make up the high frequency filters for the plate circuits of the intermediate amplifier. These chokes and their associated capacities should be of the best quality and the choke winding should be positioned well away from the chassis.

Fig. 3 is the bottom view of the chassis showing the relatively simple wiring. No difficulty should be experienced in making the finished oscillator function satisfactorily.

When the wiring is completed it will be necessary to calibrate the oscillator. This can be done easily using any commercial audio oscillator as the signal source. The signal from the commercial oscillator should be fed to the outputs of the completed job and the known oscillator set to one of the calibration frequencies desired. Then, by tuning our own oscillator very slowly through its range we will find a point where the *VI* meter will make rapid swings up and down as the energies from the two oscillators beat against each other. A position will be found where the *VI* meter settles down to a steady reading and at this point the two oscillators are at the same frequency and phase. This should be marked on the scale as one calibration point and the frequency (from the reading of the commercial oscillator) recorded. As many of these points may be taken as is desirable. If the calibrated range does not turn out to be exactly as wanted—with respect to upper and lower limits—the 100 $\mu\mu$fd. vernier tuning condenser on the "fixed" oscillator should be varied until the range is moved up or down to the position desired. Since the actual range or band of frequencies covered is governed solely by the tuning condenser on the variable oscillator, use of the 100 $\mu\mu$fd. vernier merely serves to slide this fixed band of frequencies up or down. In our case we chose settings giving us a band of oscillator output frequencies from 30 to 20,000 cycles.

While any type tuning dial may be used on the oscillator the one shown in the photographs was chosen for quick changes in setting and ease of reading. A chart of dial readings versus frequency is on top of the oscillator case. A long slide rule type dial might be preferred by some constructors as frequencies could be noted directly on such a dial.

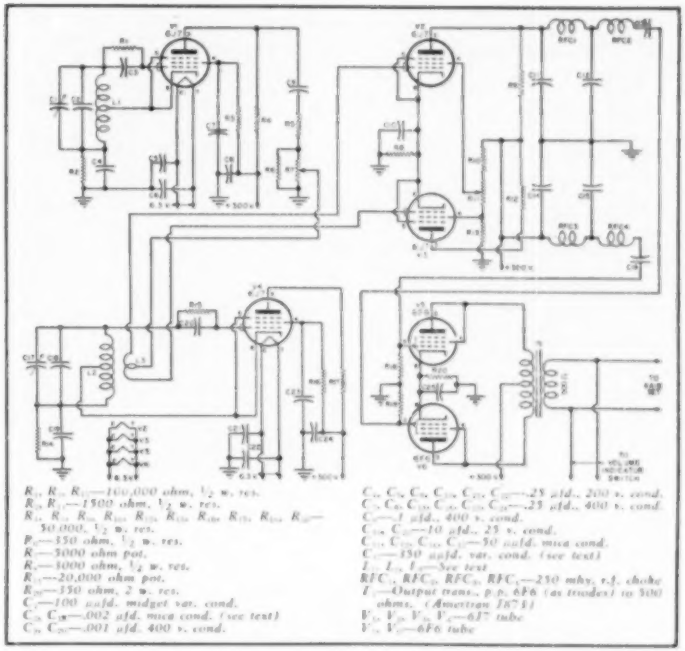
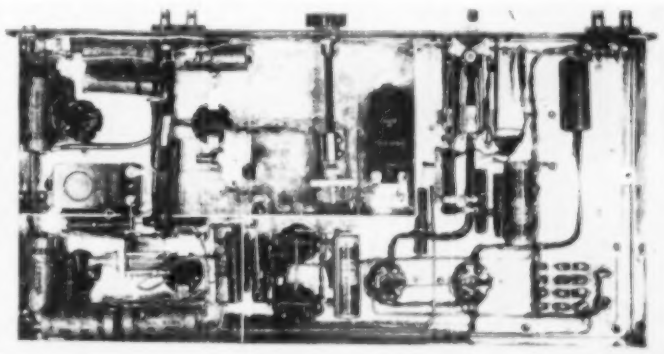

R_1, R_{16}—100,000 ohm, ½ w. res.
R_2, R_{17}—1500 ohm, ½ w. res.
R_3, R_4, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15}, R_{18}—50,000, ½ w. res.
P_1—150 ohm, ½ w. res.
R—5000 ohm pot.
R_5—5000 ohm, ½ w. res.
R_{19}—20,000 ohm pot.
R_{20}—350 ohm, 2 w. res.
C_1—100 $\mu\mu$fd. midget var. cond.
C_2, C_3—.002 μfd. mica cond. (see text)
C_4, C_{20}—.001 μfd. 400 v. cond.
C_5, C_6, C_7, C_8, C_{11}, C_{12}, C_{13}—25 μfd., 200 v. cond.
C_9, C_{10}, C_{14}, C_{15}, C_{16}, C_{17}—25 μfd., 400 v. cond.
C_{18}—1 μfd., 400 v. cond.
C_{19}, C_{21}—10 μfd., 25 v. cond.
C_{22}, C_{23}, C_{24}, C_{25}—50 $\mu\mu$fd. mica cond.
C_{26}—350 $\mu\mu$fd. var. cond. (see text)
L_1, L_2—See text
RFC$_1$, RFC$_2$, RFC$_3$, RFC$_4$—250 mhy. r.f. chokes
T—Output trans., p.p. 6F6 (as triodes) to 500 ohms. (American 1875)
V_1, V_2, V_3, V_4—6J7 tube
V_5, V_6—6F6 tube

Fig. 2. Complete wiring diagram of the beat frequency oscillator circuit.

In order that we may use the oscillator in making gain runs or performance curves on transmitters, audio amplifiers, filters, equalizers, tone control circuits, etc., it is necessary to have a variable attenuator, "losser" or, as we shall call it, a calibrated gain set. It is the function of this gain set to insert in the circuit an attenuation or loss very nearly, if not exactly, equal to the gain through the amplifier being measured. Thus, if we have 0 level out of our test oscillator and are to feed an amplifier having 40 db. gain we can set our attenuator or gain set for 40 db. attenuation or loss which causes the signal to enter the amplifier at minus 40 db., then experience a gain of 40 db. and emerge at 0 level. Thus the original and final levels are compared by means of the *VI* and since we attenuated the oscillator output 40 db. to obtain this equality of *VI* reading between the input and output (the *VI* always reading across a 500 ohm line as will be explained later) we can say that the amplifier has a gain of 40 db. In general we can say that any amplifier being measured has a gain in db. equal to the db. loss inserted by the gain set when the *VI* readings are the same on the oscillator output and the amplifier output—the *VI* being given a 500 ohm termination out of the amplifier as it already has out of the oscillator (see Fig. 6). This

Fig. 3. Bottom view of the oscillator chassis. Note careful shielding and parts placement.



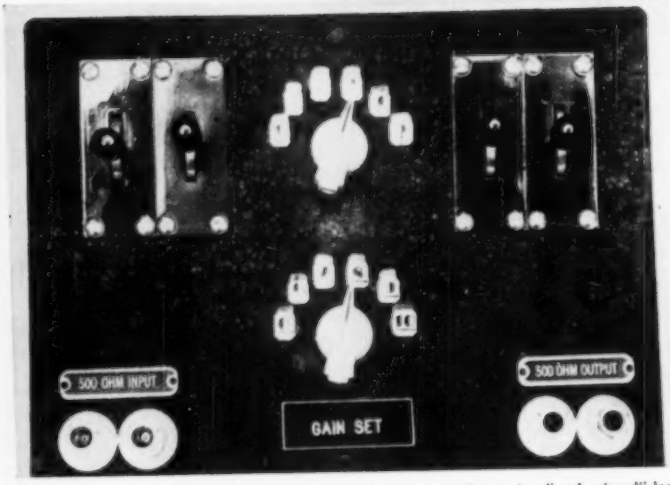


Fig. 4. Panel view of gain set. Controls are placed symmetrically to give "professional" look.

will be dealt with at greater length under the measuring procedure to be described later.

Fig. 4 shows the small gain set unit employed with the oscillator in audio measurements. The gain set has a total possible attenuation of 110 db.

Fig. 5 shows the circuit arrangement of the gain set. The resistors were 1 watt carbons and each was originally chosen for having a value of resistance somewhat lower than that ultimately required for that resistor. Each resistor was then connected across a Wheatstone Bridge which was set for the wanted value of resistance and a three-cornered file used to file a "V" slot in the body of the resistor thus decreasing its cross section and consequently raising its effective resistance. Filing was continued until the correct value was reached, as indicated by balance on the bridge.

As may be seen from the wiring diagram there are four fixed pads of 10, 20, 30, and 40 db. loss respectively which can be placed in the circuit by means of key switches of the anti-capacity type which are mounted on the front panel.

In addition, ten steps of a fixed value of 1 db. loss can be placed in the circuit by the two knobs on the front panel, each knob providing a range of from 0 to 5 db. loss.

By proper positioning of the knobs, or point switches, and the anti-capacity keys any attenuation from 0 to 110 db. may be placed in the circuit. The only precautions to be taken in building up the gain set is to keep all the elements well separated and wires well spaced from each other. If these precautions are observed excellent accuracy can be obtained. On checking our set against a standard commercial set our set had a maximum error of 0.4 db. at the maximum setting of 110 db.

Although the case of our gain set measures only 6" x 8" x 6" deep a slightly larger case would perhaps be desirable from the standpoint of construction and wiring.

The resistors comprising the fixed value pads of 10, 20, 30, and 40 db. loss are mounted directly on the elements of the anti-capacity switches and wired so that when the handle is in the "up" position the top contact (shown neutral for all series elements in Fig. 5) is opened and the lower contact—that for the shunt element—is closed. These switches are shown in the diagram of Fig. 5.

This puts the resistances for that particular pad in the circuit and causes the proper loss for the pad in use.

With the handle in the "down" position the series resistors are shunted out of circuit and the circuit of the shunt resistors is opened, thus taking that particular pad out of circuit.

The two switches showing the semi-circular shorting-plate segments at the bottom of Fig. 5 each represent one deck of the unit (1 db.) switches shown on the front panel, the top group 0-5 db. and the bottom group 6-10 db., each with its off position. These are *Centralab* Type G 10-position, single-pole shorting type and serve to connect the successive shunt resistors of the 1 db. pads in the circuit as the switch knob is rotated to the right.

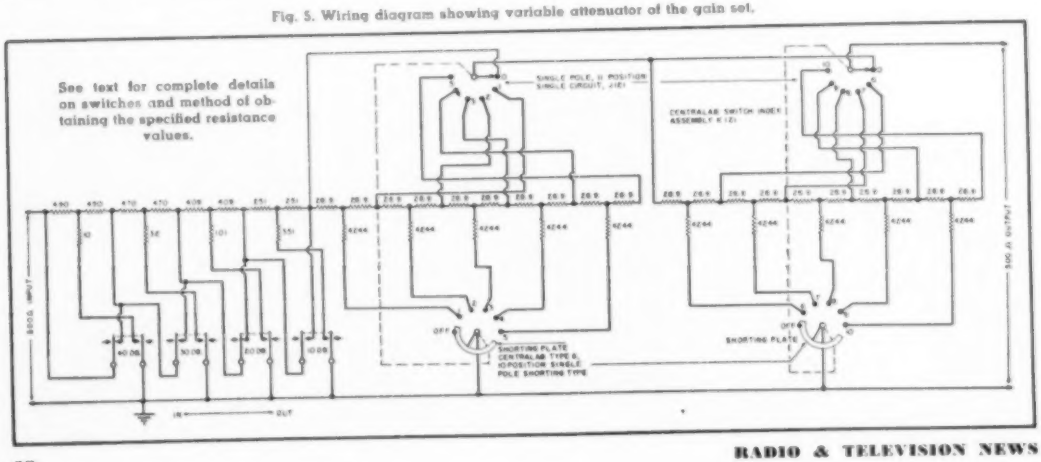
The second deck of this switch assembly (on a *Centralab* switch index assembly K 121) is a *Centralab* single-pole, 10-position, single-circuit Type J 121. Thus, the two decks on each unit switch are operated simultaneously and serve to connect the series and shunt resistors of the successive 1 db. pads in the circuit as the switch knob is rotated to the right.

For frequency stability, no heat-developing power supply was mounted on the chassis with the oscillator components. Any well-filtered supply capable of furnishing 6.3 volts at 3 amp. a.c. for the filaments and 300 volts at 80 milliamperes for the plates will be adequate.

Although the technique of making

(*Continued on page* 108)

Fig. 5. Wiring diagram showing variable attenuator of the gain set.


See text for complete details on switches and method of obtaining the specified resistance values.
SINGLE POLE, 11 POSITION SINGLE CIRCUIT, J121
CENTRALAB SWITCH INDEX ASSEMBLY K 121
500Ω INPUT
500 Ω OUTPUT
SHORTING PLATE CENTRALAB TYPE G 10-POSITION SINGLE POLE SHORTING TYPE
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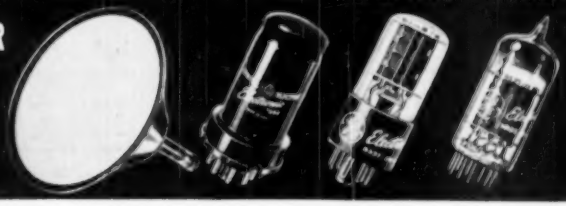

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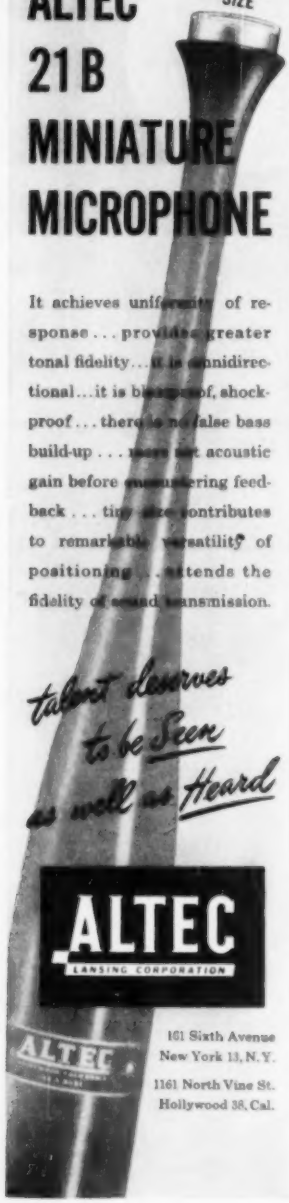

It achieves uniformity of response . . . provides greater tonal fidelity . . . it is omnidirectional . . . it is bleedproof, shockproof . . . there is no false bass build-up . . . more net acoustic gain before encountering feedback . . . tiny size contributes to remarkable versatility of positioning . . . extends the fidelity of sound transmission.

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A Volume-Compensated TONE CONTROL

By ALAN SCHWAN

When it comes to audio controls, most of the emphasis has been placed on tone compensated volume controls. What about volume compensation in the tone control circuit? Here's one answer.

IF YOU are an audio enthusiast whose resources are limited, you want to get as much as possible out of your investments. You have probably played around with various and assorted tone control circuits with some extremely tepid results only because feeding the family must be put before buying parts for that "really good" tone control. If our respective problems are similar, your trouble has been a three-way battle: effect on frequency vs. effect on volume vs. effect on wallet.

Fig. 1 is the schematic of a tone control flexible enough for almost any job; it can be adjusted for constant power output, constant voltage output, or constant apparent volume level. What's more, the triodes more than make up for the reduction of signal level due to filter attenuation. In fact, a .5 volt crystal pickup is being run through this circuit directly to the phase inverter with plenty of gain to spare.

Here's how it works. Condenser C_1 filters out the lows so that V_{1a} acts as a treble amplifier, and C_2 makes V_{1b} a bass amplifier. Now, if the arm of R_4 is set at the V_{1a} side, it will tap off the output of V_{1a} with no attenuation from R_4. But the signal from V_{1b} has 1 megohm of resistance to the final output and only 50,000 ohms to ground, so little of it gets through. Operation is similar with a setting near the V_{1b} side. Any intermediate position just changes the ratio between the output voltages received at the arm. The loading (R_4) of R_4 should be kept to a minimum (over 500,000 ohms), or volume will drop considerably when R_4 is at center position. Running it straight into a grid is the best system, but a 1 meg. volume control doesn't reduce volume to any great extent.

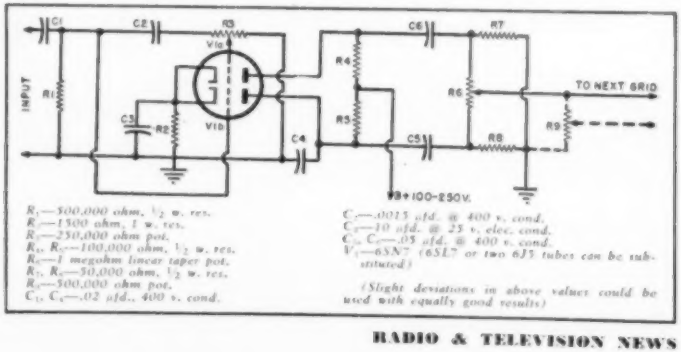
Adjustment is simple. Resistor R_3 varies the gain of V_{1a}, the treble amplifier and the amount of high frequency signal to R_4. If constant volume level is desired, turn R_4 to the V_{1b} (bass) side and set volume at a comfortable position. Then move the arm of R_4 to the extreme V_{1a} side, and adjust R_3 to a point where the volume is the same as when R_4 was at V_{1b} side. For constant power or voltage characteristics, follow the same procedure, but make output measurements instead of listening tests.

If you haven't enough room, or for some other reason you don't wish to use a potentiometer at R_4, fixed resistors can be used if their ratio is kept within certain bounds. Make the hot side about four times the grid-to-ground resistance. This will vary depending on the other component values used. In this construction, the values range from 35,000 ohms to ground in one amplifier to 70,000 ohms to ground in another; both use 250,000 ohm pots.

When built and adjusted correctly, this circuit will have *no* effect on volume but will have a tremendous frequency response range.

—30—

Fig. 1. Schematic diagram of tone control circuit.



R_1—500,000 ohm, ½ w. res.
R_2—1500 ohm, 1 w. res.
R_3—250,000 ohm pot.
R_4, R_6—100,000 ohm, ½ w. res.
R_5—1 megohm linear taper pot.
R_7, R_8—50,000 ohm, ½ w. res.
R_9—500,000 ohm pot.
C_1, C_6—.02 mfd., 400 v. cond.
C_2—.0015 mfd. @ 400 v. cond.
C_3—10 mfd. @ 25 v. elec. cond.
C_4, C_5—.05 mfd. @ 400 v. cond.
V_1—6SN7 (6SL7 or two 6J5 tubes can be substituted)

(Slight deviations in above values could be used with equally good results)

Heathkits ARE THE QUALITY LINE OF TEST EQUIPMENT KITS

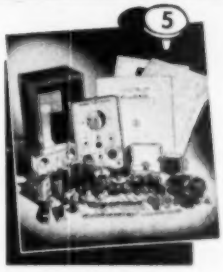
MODERN STYLING

Heathkits have brought a new conception of beauty to laboratories and service benches.

Many organizations have standardized on Heathkits to make their shops appear attractive and uniform.

The panels are produced in grey and maroon and the modern streamline aluminum handles give the instruments a pleasant, professional appearance.

There is no waste space or false effort to appear large in Heathkits — space on service benches is at a premium and the size of Heathkit instruments is kept as small as is consistent with good engineering design.



COMPLETE KITS

When you receive your Heathkit, you are assured of every necessary part for the proper operation of the instrument.

Beautiful cabinets, handles, two-color panels, all tubes, test leads where they are a necessary part of the instrument, quality rubber line cords and plugs, rubber feet for each instrument, all scales and dials ready printed and calibrated. Every Heathkit is 110V 60 cy. power transformer operated by a husky transformer especially designed for the job.

BEST OF PARTS

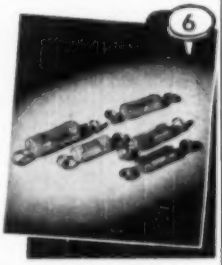
You will find many famous names on the parts in your Heathkit. Mallory switches and filter condensers, Chicago Transformer Corporation and Electrical Assembly Transformers, Centralab Potentiometers, Belden Cable, IRC and Allen Bradley resistors, G.E. tubes, Cinch and Amphenol sockets with silver plated contacts, Defiance variable condensers, Eby binding post and many other quality parts. The finest of parts are used to assure long trouble-free service from Heathkits.

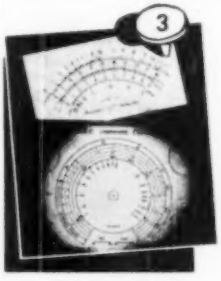
PRECISION PARTS

Wherever required, the finest quality 1% ceramic resistors are supplied. These require no aging and do not shift. No matching of common resistors is required. You find in Heathkit the same quality voltage divider resistors as in the most expensive equipment.

The transformers are designed especially for the Heathkit unit. The scope transformer has two electrostatic shields to prevent interaction of AC fields.

These transformers are built by several of the finest transformer companies in the United States.

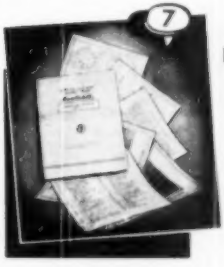




LARGE EASILY READ CALIBRATIONS

No charts or calculations are necessary to use any Heathkit properly. All scales are simply and plainly marked.

The operator instantly knows the proper use of the instrument and can proceed confidently. No multiplication is required as each scale is calibrated independently of the others.



COMPLETE INSTRUCTION MANUALS

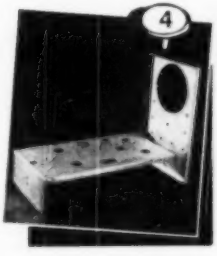
Everyone is pleased at the thorough instructions covering the assembly of each Heathkit instrument. Every detail of the assembly is covered, together with sections on the use of the instrument and trouble shooting instructions in case of difficulty. Actual photos of the assembled instrument enable fast and accurate assembly, clear schematics and pictorial diagrams of the confusing parts such as rotary switches, enable the wiring to be completed quickly.

KITS THAT FIT

Heathkit chassis are precision punched to fit the quality parts supplied. The grey crackle aluminum cabinet and the two-color panels are die punched to assure proper fitting.

Many builders have written marveling at the ease with which assembly can be accomplished.

The chassis are specially engineered for easy assembly and wiring — there are no small, tight corners which cannot be reached—the ends of the chassis are left open in order that installation of parts and soldering can be done with both hands.



IDEAL FOR SCHOOLS

Heathkits have been adopted as standard equipment at many of the largest universities and colleges. The low cost plus the fact that the students learn by actual assembly make them ideal training mediums. Many high schools and small colleges are finding that they too can have a modern physics and electronics laboratory by using Heathkits.

Some of the largest technical schools recommend Heathkits to their students as the best means of securing the necessary equipment to start their own shops.

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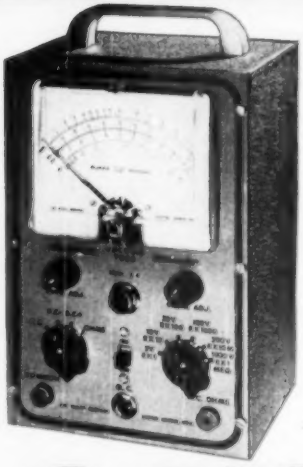
The NEW V-4 *Heathkit*
VACUUM TUBE VOLTMETER KIT



Features

- Meter scale 17% longer than average 4½" meter.
- Modern streamline 200 ua meter.
- New modern streamline styling.
- Burn-out proof meter circuit.
- 24 Complete ranges.
- Isolated probe for dynamic testing.
- Most beautiful VTVM in America.
- Accessory pr bes (extra) extend ranges to 10,000 Volts and 100 Megacycles.
- Uses 1% precision ceramic divider resistors.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.

The new Heathkit Model V-4 Vacuum Tube Voltmeter has dozens of improvements. A new modern streamlined 200 microampere meter has Alnico V magnet for fast, accurate readings. The new electronic AC voltmeter circuit incorporates an entire new balance control which eliminates contact potential and provides greater accuracy. New simplified switches for quicker assembly. New snap-in battery mounting is on the chassis for easy replacement.

The Heathkit VTVM is the only kit giving all the ranges. Check them — DC and AC full scale linear ranges of 0-3V, 0-10V, 0-30V, 0-100V, 0-300V, 0-1000V and can be extended to 0-3000V and 0-10,000V DC with accessory probe at slight extra cost. Electronic ohmmeter has six ranges measuring resistance accurately from .1 ohm to one billion ohms. Meter pointer can be offset to zero center for FM alignment.

The DC probe is isolated for dynamic measurements. Has db scale for making gain and other audio measurements.

The new instruction manual features pictorial diagrams and step-by-step instructions for easy assembly. The Heathkit VTVM is complete with every part — 110V transformer operated with test leads, tubes, light aluminum cabinet for portability, giant 4½" 200 microamp meter and complete instruction manual.

Order now and enjoy it this entire season. Shipping weight 8 lbs., Model V-4.

$24.50

THE FINEST VTVM KIT AVAILABLE FOR THIS PRICE.

Accessory: 10,000V high voltage probe, No. 310, $4.50.
Accessory: RF crystal diode probe kit extends RF range to 100 Mc., No. 309, $6.50.

New Heathkit
HANDITESTER KIT

Features

- Beautiful streamline Bakelite case.
- AC and DC ranges to 5,000 Volts.
- 1% Precision ceramic resistors.
- Convenient thumb type adjust control.
- 400 Microampere meter movement.
- Quality Bradley AC rectifier.
- Multiplying type ohms ranges.
- All the convenient ranges 10-30-300-1,000-5,000 Volts.
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A precision portable volt-ohm-milliammeter. An ideal instrument for students, radio service, experimenters, hobbyists, electricians, mechanics, etc. Rugged 400 ua meter movement. Twelve complete ranges, precision dividers for accuracy. Easily assembled from complete instructions and pictorial diagrams. An hour of assembly saves one-half the cost. Order today. Model M-1. Shipping wgt., 2 lbs.

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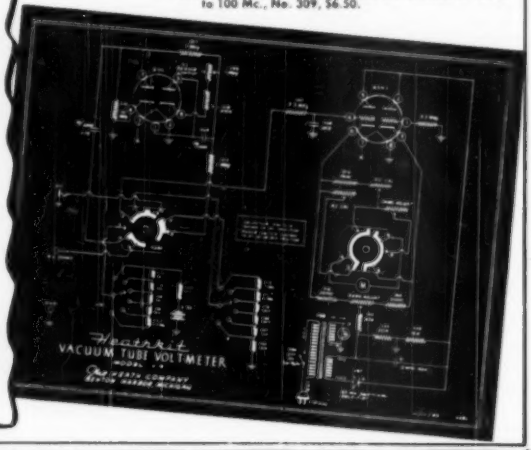

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5" OSCILLOSCOPE KIT

Features

- **The first truly television oscilloscope.**
- **Tremendous sensitivity. .06 Volt RMS per inch deflection.**
- **Push-pull vertical and horizontal amplifiers.**
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- **Extended sweep range 15 cycles to 70,000 cycles.**
- **New television type multivibrator sweep generator.**
- **New magnetic alloy shield included.**
- **Still the amazing price of $39.50.**

The new 1950 Push-Pull 5" Oscilloscope has features that seem impossible in a $39.50 oscilloscope. Think of it — push-pull vertical and horizontal amplifiers with tremendous sensitivity only six one-hundredths of a volt required for full inch of deflection. The weak impulses of television can be boosted to full size on the five-inch screen. Traces you couldn't see before. Amazing frequency range, clear, useful response at 2½ Megacycles made possible by improved push-pull amplifiers. Only Heathkit Oscilloscopes have the frequency range required for television. New type multivibrator sweep generator with more than twice the frequency range. 15 cycles to 70,000 cycles will actually synchronize with 250,000 cycle signal. Dual positioning controls will move trace over any section of the screen for observation of any part. New magnetic alloy CR tube shield protects the instrument from outside fields. All the same high quality parts, cased electrostatically shielded power transformer, aluminum cabinet, all tubes and parts. New instruction manual now has complete step-by-step pictorials for easiest assembly. Shipping weight, 25 lbs. Model O-5

$34.50

Heathkit

ELECTRONIC SWITCH KIT

DOUBLE THE UTILITY OF ANY SCOPE

An electronic switch used with any oscilloscope provides two separately controllable traces on the screen. Each trace is controlled independently and the position of the traces may be varied. The input and output traces of an amplifier may be observed one above the other or one directly over the other illustrating perfectly any change occuring in the amplifier. Distortion-phase shift and other defects show up instantly. 110V, 60 cycle transformer operated. Uses 5 tubes (1 6X5, 2 6SN7's, 2 6SJ7's). Has individual gain controls, positioning control and coarse and fine switching rate controls. The cabinet and panel match all other Heathkits. Every part supplied including detailed instructions for assembly and use. Shipping weight 11 lbs. Model S-1

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By assembling your own laboratory equipment, you control the quality of workmanship and learn the entire story of the instrument.

New 1950 VERNIER TUNING RF

Heathkit SIGNAL GENERATOR KIT

Features

- New 5-to-1 ratio vernier tuning for ease and accuracy.
- New external modulation switch — use it for fidelity testing.
- Covers 150 Kc. to 34 Mc. on fundamentals and calibrated strong harmonics to 102 Mc.
- 400 cycle audio available for audio testing.
- Most modern type R.F. oscillator.
- New precision coils for greater output.
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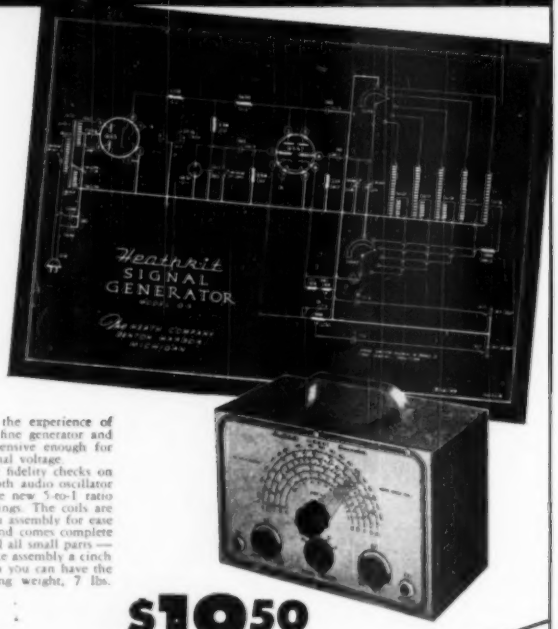

The most popular signal generator kit has been vastly improved — the experience of thousands combined to give you the best. Check the features in this fine generator and consider the low price $19.50. A best buy for any shop, yet inexpensive enough for hobbyists. Everyone can have an accurate controlled source of R.F. signal voltage.

The new features double the value — think of being able to make fidelity checks on receivers by inserting a variable audio signal. Internal 400 cycle saw-tooth audio oscillator modulates R.F. signal and is available externally for audio testing. The new 5-to-1 ratio vernier drive gives hairline tuning for maximum accuracy in scale settings. The coils are already precision wound and calibrated. Uses turret type coil and switch assembly for ease of construction. The generator is 110V, 60 cycle transformer operated and comes complete in every detail — cabinet, tubes, beautiful two color calibrated panel and all small parts — new step-by-step pictorial diagrams and complete instruction manual make assembly a cinch even for novices. Why try to get along without a signal generator when you can have the best for less than a twenty-dollar bill. Better order it now. Shipping weight, 7 lbs. Model G-5.

$19.50

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Heathkit SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Experimenters and servicemen working with a square wave for the first time invariably wonder why it was not introduced before. The characteristics of an amplifier can be determined in seconds compared to several hours of tedious plotting using older methods. Stage by stage, amplifier testing is as easy as signal tracing. The low distortion (less than 1%) and linear output (± one db) make this Heathkit equal or superior to factory built equipment selling for three or four times its price. The circuit is the popular RC tuning circuit using a four gang variable condenser. Three ranges 20-200, 200-2,000, 2,000-20,000 cycles are provided by selector switch. Either sine or square waves instantly available at slide switch. All components are of highest quality, cased 110V, 60 cycle power transformer. Mallory F.P. filter condensers, 5 tubes, calibrated two-color panel, grey cradle aluminum cabinet. The detailed instructions make assembly an interesting and instructive few hours. Shipping weight, 12 lbs. Model G-2.

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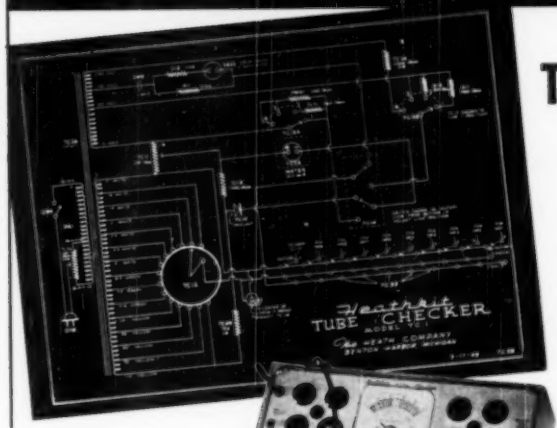

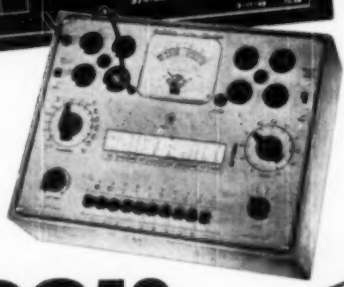

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Features

1. Measures each element individually.
2. Has gear driven roller chart.
3. Has lever switching for speed.
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5. Uses latest type lever switches.
7. Uses beautiful shatterproof full view meter.
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Check the features and you will realize that this Heathkit has all the features you want. Speed, simplicity, beauty, protection against obsolescence. The most modern type of tester — measures each element — beautiful Bad-Good scale, high quality meter — the best of parts — rugged oversize 110V, 60 cycle power transformer — finest of Mallory switches — Centralab controls — quality wood cabinet — complete set of sockets for all type tubes including blank spare for future types — fast action gear driven roller chart uses brass gears to quickly locate and set up any type tube. Simplified switching cuts necessary time to minimum and saves valuable service time. Short and open element check. No matter what arrangement of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker today. See for yourself that Heath again saves you two-thirds and yet retains all the quality — this tube checker will pay for itself in a few weeks — better build it now.

Complete with detailed instructions, all parts, cabinet, roller chart, ready to wire up and operate. Shipping weight, 12 lbs. Model TC-1.

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Now a bench 6 Volt power supply kit for all auto radio testing. Supplies 5 - 7½ Volts at 10 Amperes continuous or 15 Amperes intermittent. A well filtered rugged power supply, uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter. 0 - 15 Volt meter indicates output. Output variable in eight steps. Excellent for demonstrating auto radios. Ideal for servicing — can be lowered to find sticky vibrators or stepped up to equivalent of generator overload — easily constructed in less than two hours. Complete in every respect. Shipping wgt., 19 lbs.

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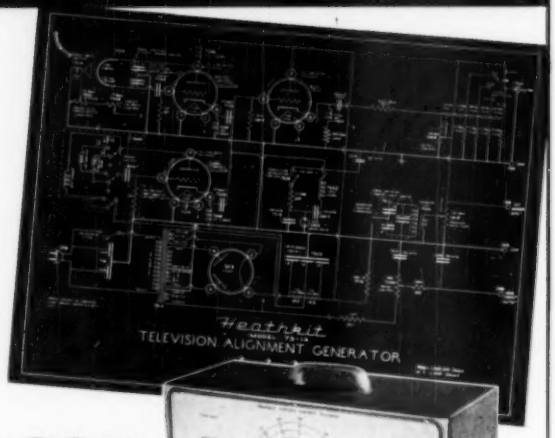
Heathkit TELEVISION ALIGNMENT GENERATOR KIT

Everything you want in a television alignment generator. A wide band sweep generator covering all TV frequencies 0 to 46 — 54 to 100 — 174 to 220 Megacycles, a marker indicator covering 19 to 42 Megacycles, AM modulation for RF alignment — variable calibrated sweep width 0-30 Mc. — mechanical driven inductive sweep. Husky 110V. 60 cycle power transformer operated — step type output attenuator with 10,000 to 1 range — high output on all ranges — band switching for each range — vernier driven main calibrated dial with over 45 inches of calibration — vernier driven calibrated indicator marker tuning. Large grey crackle cabinet 16¼" x 10¾" x 7-3/16". Phase control for single trace adjustment. Uses three high frequency triodes plus 5Y3 rectifier — split stator tuning condensers for greater efficiency and accuracy at high frequencies — this Heathkit is complete and adequate for every alignment need and is supplied with every part — cabinet, calibrated panel, all coils and condensers wound, calibrated and adjusted, tubes, transformer, test leads — every part with instruction manual for assembly and use. Actually three instruments in one — TV sweep generator — TV AM generator and TV marker indicator.



$39.50

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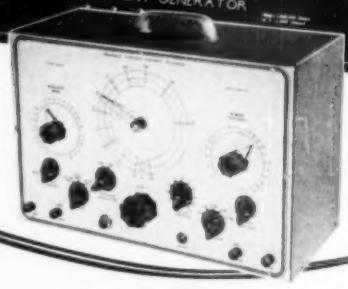
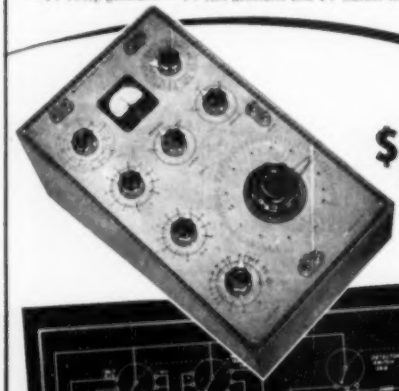
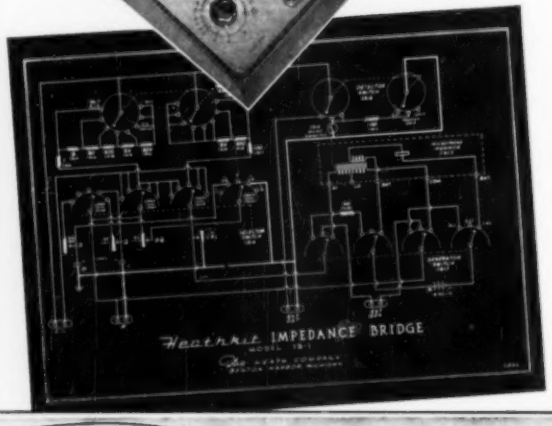
Model TS-1A





$69.50

Shipping weight 15 lbs.
Model IB-1



New Heathkit IMPEDANCE BRIDGE KIT

A LABORATORY INSTRUMENT NOW WITHIN THE PRICE RANGE OF ALL

Measures inductance from 10 microhenries to 100 henries capacitance from .00001 MFD. to 100 MFD. Resistance from .01 ohms to 10 megohms. Dissipation factor from .001 to 1. "Q" from 1 to 1000.

Ideal for schools, laboratories, service shops, serious experimenters.

An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimenters and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 microamp zero center galvanometer — ½ of 1% ceramic non-inductive decade resistors. Professional type binding posts with standard ¾" centers. Beautiful birch cabinet. Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of Silver Mica, accurate to ½ of 1% and with dissipation factors of less than 50 parts in one million. Provisions on panel for external generator and detector. Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

Internal 6 Volt battery for resistance and hummer operation. Circuit utilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited.

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The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker, locates intermittents, defective parts quicker, saves valuable service time, gives greater income per service hour. Works equally well on broadcast, FM or TV receivers. The test speaker has assortment of switching ranges to match push-pull or single output impedance. Also tests microphones, pickups, PA systems; comes complete — cabinet, 110V. 60 cycle power transformer, tubes, test probe — all parts and detailed instructions for assembly and use. Shipping Wt., 8 lbs. Model T-2.

$19.50

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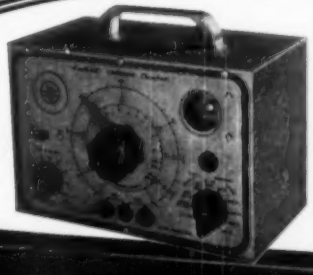

Heathkit

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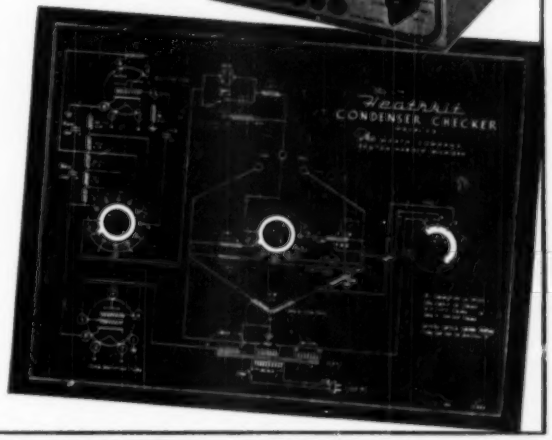
Features

- Power factor scale
- Measures resistance
- Measures leakage
- Checks paper-mica-electrolytics
- Bridge type circuit
- Magic eye indicator
- 110V. transformer operated
- All scales on panel

Checks all types of condensers, paper-mica-electrolytic-ceramic over a range of .00001 MFD. to 1000 MFD. All on readable scales that are read direct from the panel. NO CHARTS OR MULTIPLIERS NECESSARY. A condenser checker anyone can read without a college education. A leakage test and polarizing voltage for 20 to 500 volts provided. Measures power factor of electrolytics between 0% and 50%. 110V. 60 cycle transformer operated complete with rectifier and magic eye tubes, cabinet, calibrated panel, test leads and all other parts. Clear detailed instruction for assembly and use. Why guess at the quality and capacity of a condenser when you can know for less than a twenty dollar bill. Shipping weight, 7 lbs. Model C-2.



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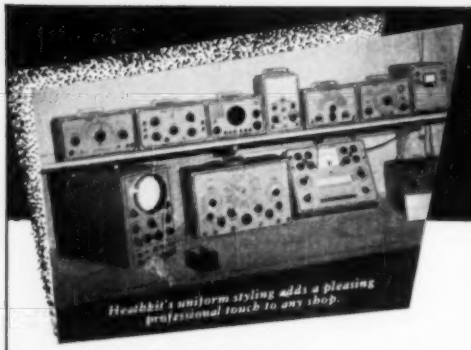


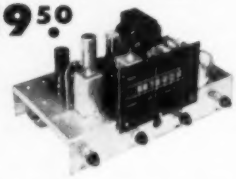
Heathkits PROVIDE PROFESSIONAL LABORATORY APPEARANCE

New Heathkit
BROADCAST AND 3 BAND SUPERHETERODYNE RECEIVER KIT

Two new Heathkit Superheterodynes featuring the best of design and material. Beautiful six inch slide rule dials — 110 V. 60 cy. AC power transformer operated — metal cased filters — quality output transformers, dual iron core metal can IF transformers — two gang tuning condenser. The chassis is provided with phono-radio switch—110 V. outlet for changer motor and phono pickup jack. Each kit is complete with all parts and detailed instruction booklet. Pictorial diagrams and step-by-step instructions make assembly quick and easy.

BROADCAST MODEL BR-1
550 to 1600 Kc.

$19.50



Ideal AC operated superheterodyne receiver for home use or replacement in console cabinet. Comes complete with attractive metal panel for cabinet mounting. Modern circuit uses 12K8 converter, 12SH7 input IF stage, 12C8 output IF stage and first audio 12A6 beam power output stage, 5Y3 rectifier. Excellent sensitivity for distant reception with selectivity which effectively separates adjacent stations.

The husky 110 V. cased power transformer is conservatively rated for long life.

The illuminated six inch slide rule dial is accurately calibrated for DX reception. Enjoy the pleasure of assembling your own fine home receiver. Has tone, volume, tuning and phono-radio controls. Chassis size 2¼" x 7" x 12½". Comes complete with all parts including quality output transformer to 3-4 ohm voice coil, tubes, instruction manual, etc. (less speaker). Shipping Wt., 10 lbs. No. BR-1 Receiver $19.50.

No. 335 Communications Type Table Model Metal Cabinet $4.50
No. 520 High Quality 5" PM Speaker for above 2.75

3 BAND MODEL AR-1
550 Kc. to 20 Mc.

$23.50

Enjoy the thrill of world wide short wave reception with this fine new AC operated Heathkit 3 band superheterodyne — amazing sensitivity 15 microvolt or better on all bands. Continuous coverage 550 Kc. to over 20 Mc. Easy to build with complete step-by-step instructions and pictorial diagram. Attractive accurately calibrated six inch slide rule dial for easy tuning. Six tubes with one dual purpose tube gives seven tube performance. Beam power output tube gives over 3 watts output.

Separately assembled coil turret with band switch eliminates difficult construction. Conservatively rated 110 V. power transformer supplies full operating voltages to all tubes for maximum reception. Has band switch, tuning, volume, tone and phono-radio controls. Chassis size 2¼" x 7" x 12½" — supplied complete — punched chassis — tubes — controls — transformers (quality output to 3-4 ohm voice coil) — all small parts — hardware and instructions (less speaker). Shipping Wt., 10 lbs. No. AR-1 Receiver $23.50.

No. 335 Communications Type Table Model Metal Cabinet $4.50
No. 520 High Quality 5" PM Speaker for above 2.75

Heathkit
PUSH-PULL HIGH FIDELITY AMPLIFIER KIT

$12.50

Build this high fidelity push-pull amplifier and save two-thirds the cost—has two pre-amplifier stages, phase inverter stage and push-pull beam power output stage. Comes complete with six tubes—quality output transformer (to 3-4 ohm voice coil) tone and volume controls—varnish impregnated cased 110V. power transformer and detailed instruction manual and all small parts. Six watt output with output flat within 1½ db between 50 and 15000 cycles.

Build this amplifier now and enjoy it for years.

Shipping Wt. 7 lbs. Model A-4
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What's New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

TV TRANSFORMERS

The addition of three horizontal deflection output and high-voltage transformers to the *Stancor* line of television replacement transformers has

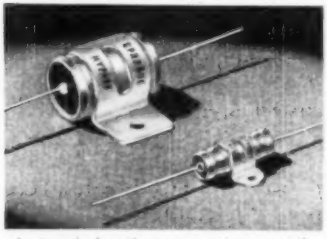
been announced by *Standard Transformer Corporation*, 3580 Elston Ave., Chicago 18.

Included are the A-8119, an exact duplicate of *RCA* Type 211T5, for use with the 16AP4 and similar kinescopes; the A-8127, an exact duplicate of *RCA* Type 211T3, for use with the 10BP4; and the A-8128, designed to fill the need for a transformer between the 10 and 16 inch sizes and also for use in converting a small receiver to a 16 inch unit.

A complete description of these replacement transformers is given in Bulletin DA5-354 which is available on request from the company.

HYPASS CONDENSERS

Sprague Products Co. of North Adams, Massachusetts is offering a line of "Hypass" 3-terminal network feedthrough condensers which are especially suited for minimizing television interference from amateur transmitters, or for attenuating power-line conducted interference from diathermy machines, industrial



electronic heating apparatus, or other high-frequency signal sources.

These "Hypass" condensers effectively bypass currents at frequencies in the v.h.f. range which ordinary units and some *LC* filters fail to do. High-voltage units were developed at the request of the ARRL. The line is available in all capacities and voltages (up to 5000 volts) for practically any high-frequency filtering requirement.

A bulletin, M-432, is available covering the line. A postcard to the company will bring your copy.

LITTELFUSE PLASTIC DISPLAY

A transparent plastic case for displaying the company's fuses and holders which can also be used as a storage compartment for screws, nuts, bolts, tackle, and other such items, has been introduced by *Littelfuse, Inc.*, 4757 N. Ravenswood Ave., Chicago 44, Illinois.

All of the fuses and holders packed in the case have been carefully selected to cover the most frequent needs of the service technician and

dealer and of the engineer in the radio, communications, instruments, and television fields.

Refilling after inventory is simple because of the transparency of the case, and the entire unit may be replaced when necessary.

SIMPSON V.T.V.M.

Designed especially for television servicing, *Simpson Electric Company's* new Model 303 vacuum-tube voltohmmeter features low current consumption and wide voltage and resistance ranges.

Although the instrument is only 120 cubic inches in size it has a large, sensitive 4½ inch 0-200 d.c. microammeter for easy and accurate readability. The d.c. input resistance is 10 megohms for all ranges providing negligible circuit loading. There are five d.c. voltage and five a.c. voltage ranges, five resistance ranges, three a.f. voltage ranges, decibels from −20 to +63 in five ranges, a zero center galvanometer for FM discriminator alignment and other galvanometer applications, and an r.f. voltage range with 20 volts maximum and flat frequency measure-

ments between 20 kc. and 100 mc. The 1% "Carbofilm" resistors used in this instrument have negligible voltage coefficient. The instrument's accuracy is maintained for line voltages varying from 105 to 125 volts. In addition, tube replacements are infrequent due to the fact that the tubes are operated at low filament and plate voltages.

The Model 303 comes equipped with a d.c. voltage probe, an a.c. voltage-ohms probe, and a ground lead. An accessory probe and a high voltage probe (30,000 volts) for measuring high cathode-ray tube voltages are available at additional cost.

As with other *Simpson* test instruments, this v.t.v.m. is accompanied by an "Operator's Manual" which is complete yet concise, and easy to understand. In addition to a complete schematic of the unit, there are diagrams of simplified d.c. voltmeter, a.c. voltmeter, and ohmmeter circuits. A complete replacement parts list is also included.

The company's main office is at 5200 W. Kinzie Street, Chicago 44, Illinois.

HI-FI AMPLIFIER

A new, low-distortion 25 watt amplifier for school auditoriums, churches, theaters, and other large-audience applications has been introduced by *Newcomb Audio Products Company* of 6824 Lexington Avenue, Hollywood 38, California.

The amplifier has a frequency response from 20 to 20,000 cycles and offers six input channels, five for microphone and one for phonograph with a built-in preamp to permit the use of magnetic pickups.

telrex brings you JACKPOT ANSWERS to your TV ANTENNA QUESTIONS

1. QUESTION—What's the one antenna that cuts installation troubles and service callbacks to the bone in all locations?
ANSWER—Telrex Conical Antennas, the conical "V" beams that cover all TV channels and FM, and afford best reception in every signal area. There's an engineer-designed, service-tested model for every TV location.

2. QUESTION—Why have Telrex Conical "V" beams replaced every possible combination of antennas for TV reception?
ANSWER—Because Telrex "V" beams are the only antennas offering true conical performance—top TV reception without bulky metal cones. For experience-designed models to meet every problem, workmanship that gives longer service . . . continue to look to Telrex!

3. QUESTION—Who has built 95% of all conical antennas installed today?
ANSWER—*Telrex!* Leadership in engineering and quality keeps Telrex out in front. The Telrex staff is ever seeking better methods, improved materials and design advancements. Supply a Telrex antenna on your next TV installation—you'll see the difference!

TELREX MODEL 2X-BD

- Bi-Directional Stacked Conical "V" Beam
- Low Vertical Angle
- Extremely High Signal to Noise Ratio
- Constant Center Impedance
- Uses 72, 150 or 300 Ohm Transmission Lines
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—the CONICAL "V" BEAM

TELREX — still your one best bet. Engineered for better pictures, built to give longer service, thoroughly field tested for your protection. Select DeLuxe Models or economy priced Special Series with equal confidence. You'll find the reputation-backed, genuine Telrex trademark on both!

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All six channels may be remote controlled from the audience by means of a control unit that weighs less than two pounds. A locked cover over the controls prevents tampering with adjustments.

An exclusive bandwidth control adjusts the frequency bandwidth of the amplifier in keeping with the program quality.

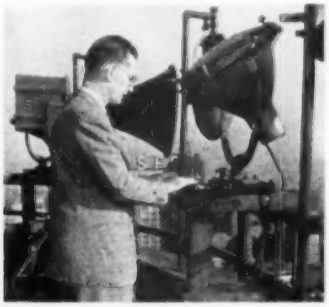
RECTANGULAR TV TUBE

Of interest to the television industry is *Hytron Radio & Electronics Corp.*'s recent announcement of the development of a directly-viewed 16-inch picture tube with a rectangular screen.

This new all-glass tube takes approximately the same cabinet space as a standard round 12-inch tube. Another feature of this picture tube is the large viewing screen. The picture, with standard 3 by 4 aspect ratio, has a usable screen area of 138.7 square inches. A neutral gray face increases the contrast ratio.

(*Continued on page* 110)

One of the features opening the Philadelphia Community Chest drive was a carillon concert and recordings of the "Voice of Billy Penn." A Stromberg-Carlson 25 note carillon was connected to 300 watts of audio power and a University B-12 speaker. It was projected from City Hall tower in Philadelphia. Coverage of the city was exceptionally good with reports of distinct understanding coming from as far as Convention Hall, a distance of 2 miles from City Hall. In the photo Burton B. Fagan is shown testing the carillon on low power before the demonstration. The carillon was installed by Edmar Communication Co. and the audio equipment was furnished by Air Tone Company of Philadelphia.



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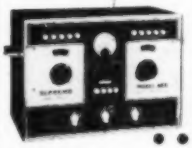
LAFAYETTE SLASHES PRICES ON SUPREME TEST EQUIPMENT



AF & RF OSCILLATOR

~~Was $141.60~~ NOW $63.95

Both AF and RF signals available at the same time — push button operated. Also has FM oscillator providing visual alignment of IF amplifiers of amplitude modulated receivers. 5 RF Ranges: 65/205 KC, 205/650 KC, 650/2050 KC, 2050/6500 KC, 6.5/20.5 MC. Harmonics above 60 MC. Frequency modulated ± 15 KC; rate 120 cps; 60-cycle time base. Range of AF oscillator: 15-15,000 cps. Output impedances: center tap transformer 50/500/5000 ohms. High impedance resistor 50,000 ohms. 110-125V., 50/60 cycles. Metal case 15½ x 11½ x 8¼". Shpg. Wt. 33 lbs. With Test Leads.

99A9633—Supreme Model 666.....**63.95**

RF SIGNAL GENERATOR

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All five ranges read on two basic scales, accurately calibrated at both ends. 65-205 KC; 205-650 KC; 650-2050 KC; 2050-6500 KC; 6.5-20.5 MC. Harmonics to 82 MC. 400-cycle audio, continuously variable voltage output. RF carrier modulated at 50% at 400 cycles; can be cut off to provide unmodulated signal. Jack for external audio modulation. Electron coupled circuit assures maximum stability. 110-125 volts, 50/60 cycles. Heavy steel case measures 9½ x 8¼ x 7-3/8". Shpg. Wt. 15 lbs.

99A9632—Supreme Model 661.....**32.95**

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All ranges selected by push-button operation with exception of 14 ampere ranges. DC Ranges: 0/70/700 microamps; 7/35/140/350 ma, 0/1.4/14 amps. DC Volts: 7 ranges at 1000 ohms/V. and 7 ranges at 25,000 ohms/V. 0/3.5/7/35/140/350/700/1400. Ohms: 0/500/5000/50,000/500,000; 0/5/50 megs. All operated by self-contained battery. AC Volts & Output Ranges: 0/7/35/140/350/700/1400. 4 DB Ranges: 0 to +46 Size: 9-1/16 x 6⅛ x 5⅛".

99A9631—Supreme Model 592...Shpg. Wt. 9 lbs.....**29.95**

Battery Kit for above. (4) Burgess No. 1 & (1) M30

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and RK similar to "AN" but an exclusive Cannon product, more rugged than type "AN". 210 inserts-layouts.

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3 insert arrangements; friction type engagement. 10 and 15 amps.

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Standard sound and microphone series in 7 insert arrangements. 15 & 30 amps. contacts.

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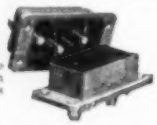

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SQUARE WAVE GENERATOR

By L. H. TRENT

CIRCUITS of square wave generators have appeared in various publications from time to time, but the majority of these employ five or more tubes, using some precision components besides. This may prohibit the average service technician from constructing them. The generator to be described has none of these disadvantages, and the components are readily available.

Frequently in audio or radio frequency work it would be an advantage to be able to inject different types of waveforms for response checking. Four types of waveforms are available from this unit. Three are used for external checking purposes, while the fourth is a sharp pulse that can be injected into the oscilloscope for locking purposes.

In reference to the schematic, Fig 2, a 6-volt auto radio vibrator unit is used as the frequency controlling element. The fundamental frequency of this particular unit is 133 cycles. However, the usable harmonics of this square wave generator extend higher than 30 megacycles. The double-pole, three-position switch, S_1, selects the first three waveforms as shown in Fig. 1 (A, B, and C). Control R_1 varies the shape of waveform (A), while control R_2 varies the shape of waveform (C). Waveform (B) is the square wave output. Waveform (D) is the scope sync.

The power supply for this unit should be able to supply a total drain of about 50 ma., and a voltage regulated tap at 105 volts for the 6L6 screen supply. Parts layout can be any way the constructor desires, as nothing is critical. —30—

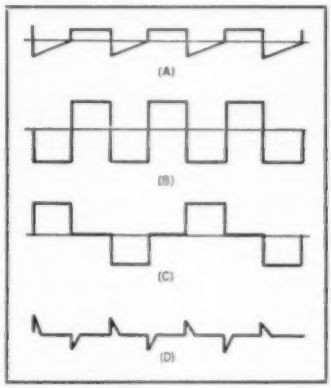
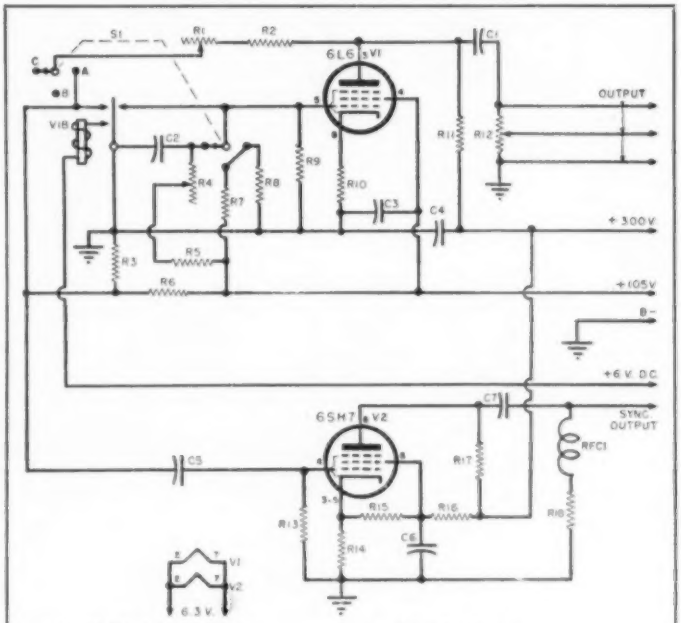


Fig. 1. Output waveforms.

Fig. 2. Wiring diagram of a square wave generator.



R_1—50,000 ohm wirewound pot.
R_2, R_3, R_{-5}—10,000 ohm, 1 w. res.
R_6, R_{11}—50,000 ohm, 1 w. res.
R_7, R_{12}—1 megohm pot.
R_8—2 megohm, ½ w. res.
R_9—250,000 ohm, 1 w. res.
R_{10}, R_{13}, R_{14}—100,000 ohm, ½ w. res.
R_{15}—500 ohm, 5 w. wirewound res.
R_{16}—15,000 ohm, 1 w. res.
R_{17}—10 megohm, ½ w. res.
R_{18}—5000 ohm, ½ w. res.
R_{19}—1 megohm, ½ w. res.
C_1—2 μfd., 600 v. cond.
C_2, C_4—.05 μfd., 600 v. cond.
C_3, C_5—10/10 μfd., 450 v. elec. cond.
C_6—.005 μfd., 600 v. cond.
C_7—.001 μfd., 600 v. cond.
RFC$_1$—10 mhy. r.f. choke
Vib.—Vibrator (Philco 23A-0026)
S_1—2-pole, 3-pos. rotary sw.
V—6L6 tube
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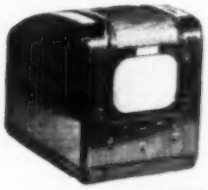
Stock No. HA-22 12x17 in. television magnifier. Made of crystal-clear plastic and oil filled. Magnifies your present 7-, 10-, or 12-inch television picture up to four times. We offer you these new factory cartoned magnifiers, you provide your own means of mounting to your set. Edge of magnifier may be drilled and hung on your set with cord. This lens is a $25.00 value, but McGee offers them to you for only $7.95. Shipped by express only. Ship. wt. 22 lbs.

V.T.V.M. KIT $23.95

Model 221-K EICO Vacuum Tube Volt Ohm Meter Kit. Dc ranges 5-10-50-100-500 volts. 7 ac r m s to 1500 rms in 5 steps. 6½" rectifier. Complete Kit, $23.95.

Model 400K—5-Inch Scope Kit. Very popular among the students and service men. Weight 40 lbs. Net, $39.95.



10" TV CABINET $5.95

Stock No. RY-10

Buy this 10" streamlined mahogany television cabinet at less than the cost of manufacture. Originally intended for use with the Farnsworth GVZ-60 television chassis, pictured to the right. It is already drilled to fit. Built-in safety shield is front. All new, size 13x19¾x17 high. Shipping weight 25 pounds. **Stock No. RY-10. Net $5.95.** Order this cabinet by itself or add on combination deal.

FARNSWORTH Partially Built-Up CHASSIS $2.95

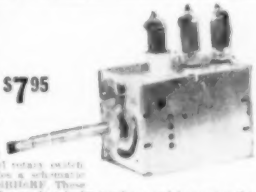
Stock No. GVZ-60

Farnsworth Television Chassis Model GVZ-60 partially built-up. Chassis size 10 x 17. Has 16 tube sockets and over 150 small parts (Resistor and Ceramic Condensers) no coils or Transformers as original unit. Saves you over $50. Circuits are all partially wired on. This TV Chassis is ideal for the amateur experimenter. Learn TV by building your own set, using this chassis to start from. Furnished with a 1948 regular $3.00 Supreme Publications Television Manual which has a complete schematic of this chassis as well as pages of service information on Farnsworth GVZ-60 partially built-up Chassis and 48 Supreme TV Manual. **Net price, $2.95.** Shipping weight 15 lbs. Outside portage for 11 lbs. GVZ-60 Chassis only **$2.95.**

McGee's TV SCOOP!

SARKES TARZIAN 13 CHANNEL TELEVISION FRONT END $7.95

This Popular T.V. Tuner Is Used on Current T.V. Set Production SARKES-TARZIAN



The Sarkes-Tarzian 13-channel front end is the most popular now in use outside of RCA. It is a 13-channel rotary switch type, with individually slug-tuned coils. Price includes a schematic diagram and 3 tubes: 6C4 oscillator, 6AG5 mixer, and 6BH6RF. These tuners cost the manufacturer over twice our price. McGee made a lucky purchase and is passing the saving on to you. 2 types are offered below. Type 1 is used on popular intercarrier circuits, type 2 and type 3 are used on separate sound IF circuits. Type 3 differs from type 2 in that the input IF coil is mounted and connected to the tuner and has taps for the video and sound IF. Shipping weight 3 lbs.

TUNER TYPE 1 $6.95
Type 1 is as pictured, except has no fine frequency adjustment; complete with tubes. Net price, $6.95.

TUNER TYPE 2 $7.95
Type 2 is as pictured above in the Fe-ture. Has 11 position drive fine frequency control and tubes. Net price, $7.95.

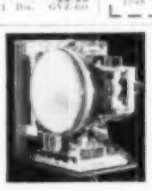
TUNER TYPE 3 $9.95
Type 3 is the same tuner as type 2, but has the input IF coil attached for separate sound and video IFs, with tubes. Net price, $9.95.

BUY ALL 3—T.V. CABINET—CHASSIS—TUNER $14.95

Sarkes-Tarzian Type 2 tuner, RY-10 cabinet and Farnsworth TV chassis. Shipping weight 65 lbs. Specify **Stock No. TV-3BX**, all for $14.95. If Supreme 1948 TV Manual is desired, add $1.00 extra.

NATIONALLY FAMOUS 15-INCH CUSTOM CHASSIS WITH PICTURE TUBE

Regularly $250.00
McGEE'S SCOOP PRICE $169.95



Mcgee does it again. We bought 150 of this nationally advertised brand, 23 tube television chassis. We are withholding the manufacturers name at their request. These were made to sell for $250.00, by a famous builder of amateur radio sets. It is the finest construction with 2 separate power supply with heavy duty transformer. Has 8" heavy duty speaker. This is a complete manufactured television chassis, with 23 tubes, including the 15BP4 picture tube. When it is time for you to replace the picture tube, a 10" size will fit right in. Tubes included are: 2-6AU6, rf amp., mixer and osc.; 2-6AL5, 1st, 2nd, 3rd and 4th IF amp., 1st video amp., audio IF amp. and audio amp.; 3-6AL5, video det., 1st det., and sync. det.; 1-6AQ5, 2nd video amp.; 1-12AT7, sync. separator, restore and sync. phase inverter; 2-6SN7, horizontal oscillator and amp.; 1-6K6 audio output; 1-12AU4 horizontal damper; 1-6BT4 high voltage rectifier; 1-5V4 rectifier; 1-6AU4 sound discriminator; 1-6X4 low voltage rectifier. This chassis is all mounted on polished aluminum panel set in beautiful stripped wood with picture tube installed. We know this is the best TV chassis value in the U.S. today. If you do not recognize the value figure, take this ad to competitor by letter. However, there are only 150 sets to sell, so don't delay ordering. Shipping weight 100 lbs. Size 20x15x8. Maximum space required for mounting as above 20 x 20½ high x 23" deep. Net price, complete with all tubes and the 15BP4 picture tube, ready to operate, **$169.95**

30-TUBE T.V. CHASSIS Built from RCA Material for 16" Tube $169.95

Long Picture Tube

This is not a kit but a complete 30-tube television receiver chassis made by a famous company from RCA parts. Price includes all tubes except the picture tube. Proper voltage drop for 16-inch tube operation, all the latest improvements included in this chassis. This is an ideal TV set for remote operation. **Stock No. R-1486**, 14 x 6 picture tube, $169.95. 16-inch glass picture tube, $45.95 extra.

SALE ON T.V. PICTURE TUBES

Guaranteed first line Television picture tubes. Made and guaranteed by a nationally known set manufacturer. Every tube guaranteed.

10 inch 10BP4 picture tube	$39.95
12 inch 12LP4 picture tube	27.95
16 inch 16LP4 all glass picture tube	45.95

T.V. BOOSTER—REGENCY—$17.61 ANCHOR—$22.05

Regency DB-213 low and high band television booster. Dual 6J6 tubes with iron core push pull RF amplification. For either 73 or 300 ohm input. With booster off, Ant. is connected direct to receiver. Weight 3 lbs. Net, **$17.61**

Anchor Model ARC-101-SO. Ever popular low and high band TV booster. Carefully engineered and finely constructed. Ship. weight, 6 lbs. Net, **$22.05**

T.V. Power Transformer, similar to R.C.A. 250 Ma. 110 Volts, 60 Cycle 700 Volts D.C. Filaments 5 Volts at 2 amps., 5 Volts at 3 amps. and 6.3 Volts at 6 amps. Type size 3¼x4½x5¼". Shipping weight 12 lbs. Stock No. MO-4F. Net price, **$5.95**

100 RADIO TUBES $29.95

250,000 Tubes for Sale. Tremendous value. Tubes up to $3.00 list. 100 Cartoned and branded Hyvac Miniature Tubes for $29.95. Over a million sold. Guaranteed full replacement. 34c Each in smaller quantities.

1B5	12AT6	12BF6	6AQ5	6AU6	9002
6T4	35W4	50L6	6AQ8	6BN8	9003
1U5	35Z5	6BE6	6C4	117Z3	
3A4	50A5	6BG6	6J4	1S5	
3S4	50B5	6C4	6K4	1T4	
3V4	12AT7	6AL5	6W4	6BJ6	
3Y4	12AU7	6AQ5	6AG5	6AT6	
3Q4	12AX7	6BF6	6AU6	6BA7	
3S4	12BA7	6AU7	1299	6BJ6	
12A6	12AU6	6BU7	9001	35C5	
12SF5					

$29.95 for 100
34c each

Popular G.T. Cartoned and Branded HYVAC *Guaranteed Full Replacement* **39c Ea.**

1B4	6J5	6SD7	6SU7	12SF7
6V6	6J7	6SF5	6V6	12SH7
5Y4G	6K5	6SJ7	6W6	12SN7
6AC5	6K6	6SK7	12A6	25L6
6BG6	6K7	6SQ7	12AT7	35Z5
6C5	6P5	6SN7	12K8	35Z5
6C6	6S8	6SR7	12SA7	70L7
6F6	6SA7	6SS7	12SA7	80

HYVAC 49c BRACKET

6BG6 6J6 6AK5 2A3

STANDARD BRAND Every Day Numbers 59c

12SA7GT 12SK7GT 12SQ7GT
35L6GT 50L6GT

6L6GA—$1.09 each, 10 for $10.00

Western Electric Type 1001F, a super heavy duty 6L6 jacks 100 or less. Plugs in for 6L6. **$1.98 each; 10 for $17.95.**

STANDARD BRAND TUBES

CARTONED and UNCARTONED 49c

6T4	35A5	6L7	7A5	12A6	12Z3	39	
1A6	5T4	6N7	7A6	12A8	14A7	43	
1A6	5V4	6P3	7A7	12AH7	14B6	4525	
1B4	5Y3	6Q7	7B4	12AT6	14C7	5085	
1B4	5Y4	6SA7	7B5	12BA6	14H7	56	
1C5	6A8	6SC7	7B6	12BD6	14Q7	57	
1C7	6AC7	6SD7	7B8	12BE6	14R7	58	
1D7	6AG7	6SF5	7C6	12C8	19	70L7	
1D7	6B6	6SF7	7C5	12F5	25A6	75	
1D8	6C4	6SG7	7C6	12H6	25Z5	78	
1F4	6C5	6SH7	7C7	12J5	25Z6	77	
1F5	6C6	6SJ7	7E5	12K8	26	78	
1G4	6C8	6SK7	7E7	12Q7	27	80	
1G5	6D8	6SL7	7F7	12SC7	30	6B7S	
1H5	6E5	6SQ7	7H7	12SF5	32	807G	
1L6	6F7	6SR7	7L7	12SF7	33	81	
1L4	6H6	6S7	7N7	12SG7	34	3585	
1R5	6J5	6T7	7Q7	12SH7	35	306	
1S5	6J7	6U5	7R7	12SJ7	3585	1644	
1T4	6K5	6S5	7S7	12SL7	3595	1217	
1V	6K6	6T6	7V7	12SN7	3524	6AT6	
2A5	6K7	6Z7	7Y4	12SQ7	3525	6BA6	
2A6	6K8	6ZY5	12A	12SR7	38		
2A7	6L5	7A4	12Y				

Horizontal deflection output transformer, No. T117, same as RCA type 211T1 or 211T2. Net, $1.49.

Vertical oscillator transformer (Blocking) No. T117, same as RCA type 209T2. Net, $1.59.

Focus coil, 247 ohms DC resistance, No. T122, same as RCA type 203D1. Net, $2.49.

Deflection yoke, 812 MH, certing, No. MH. No. T121, same as RCA type 201D1. Net, $2.95.

Vertical deflection output transformer, No. T116, same as RCA type 204T2. Net, $1.95.

TV power transformer, similar to RCA 200 ma 118 volts, 60 cycle. 740 volts DC. Filaments 2.5 volts at 2 amps., 5 volts at 3 amps., and 6.3 volts at 6 amps. Size 3¾x 4¾x5¼". Shipping weight 12 lbs. Stock No. MO-4F. Net, $5.95.

1st and 2nd sound IF transformers, No. T106, same as RCA type 214K1. Each, $1.25.

1st pix IF transformer, No. T101, same as RCA type 202K2. Each, $1.09.

2nd pix IF transformer, No. T102, same as RCA type 202K3. Each, $1.08.

Sound discriminator transformer, No. T104, same as RCA type 203K1. Each, $1.59.

Horizontal sync discriminator transformer, No. T105, same as RCA type 205T5. Each, $1.49.

3rd and 4th pix coils, No. T103, same as RCA type 202K4. Each, $1.39.

Carbide trap coil, No. T108, same as RCA type 202K6. Each, $1.29.

Video peaking coil, 250 MH, shunt resistance 10 megohms, No. T107, same as RCA type 202K5. Each, $.27.

Video peaking coil, 250 MH, shunt resistance 15 megohms, No. T109, same as RCA type 202K7. Each, $.27.

Video peaking coil, 120 MH, shunt resistance 22 megohms, No. T110, same as RCA type 202K8. Each, $.27.

Video peaking coil, 93 MH, shunt resistance 10 megohms, No. T111, same as RCA type 202K9. Each, $.27.

Video peaking coil, 93 MH, shunt resistance 15 megohms, No. T118, same as RCA type 204K1. Each, $.15.

Filament choke, 58 MH, No. T115, same as RCA type 204K1. Each, $.15.

Width control coil, No. T112, same as RCA type 201H1. Each, $.46.

Horizontal linearity control coil, No. T113, same as RCA type 201H3. Each, $.46.

McGEE RADIO COMPANY

PRICES F.O.B. K.C. Send 25% Deposit with order. Bal. Sent C.O.D. With parcel post orders include postage.

TELEPHONE VICTOR 9045. Write for Flyer
1422 GRAND AVE., KANSAS CITY, MISSOURI

FM-AM RADIO-PHONO COMBINATION

Sale Price $59.95

Hallicrafters S-59 chassis and ready cut blond console cabinet and VM-400 dual speed record changer. Heavy duty 6 inch speaker. All you do is install the chassis and changer in the cabinet, all drilling and cutting is already done. This gives you a complete FM/AM radio phono. comb. for only $59.95. Stock No. C-859X. Shipping weight 60 lbs. Sale price $59.95.

hallicrafters

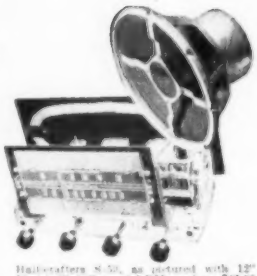
S-59 8-TUBE FM-AM CHASSIS A $50.00 VALUE

$32.95

Model S-59 Hallicrafters, high fidelity, 8 tube FM/AM chassis, for custom installations. Receives broadcast 540 to 1700 kc and FM 88 to 108 mc. Size 12¾x5⅞x9". An excellently engineered chassis, with accurately calibrated slide rule dial. Variable tone control and 60 to 14,000 CPS wide range audio. (Push-pull 6K6's) 8 ohm output transformer will match most speakers. No special output transformer required. Loop antenna built on for broadcast reception. Includes tubes: 2—6BA6, 6BE6, 6AL5, 6SQ7, 2—6K6 and 5Y3. This is without a doubt the most radio chassis we have been able to offer. Better rush your order now. We have them.

S-59. 8 tube FM/AM chassis, with tubes. Weight 16 lbs. Net $32.95.

S-59. 8 tube FM/AM chassis, with tubes and regular $12.95, 12" coaxial PM speaker, CR-12X. Weight 24 lbs. Net $42.95.



Hallicrafters S-59, as pictured with 12" Model CR-12X coaxial RM speaker. $42.95
S-59 less speaker $2.95
Pre Amp. A/c with S-56. Also works up S-59.

RADIO SERVICEMEN—McGEE HAS 100,000 SPEAKERS IN STOCK—LOWEST PRICES

WIDE RANGE AMP-KIT $29.95

It's the newest thing in audio amplifiers. McGee's wide range 14 watt amplifier kit with inputs for crystal or dynamic mikes and any crystal phono cartridge, as well as the new G.E. variable reluctance cartridge. Output transformer is wire wound, weighs 6 lbs. Voice coil taps 4-8-15-250 and 500 ohms. Push-pull 6L6 output tubes. Separate electronic bass and treble tone. Inverse feedback. Input tube filament is DC heated to reduce hum level to oil. Frequency response from 20 to 20,000 cps. Easy to follow diagram and photos for easy assembly of this kit. Ready punched chassis. Every part furnished including tubes: 2-6L6, 6C4, 6SN7, 12AV7. Shipping weight 25 lbs. Stock No. 47-51, net $29.95.

12-WATT AMP. KIT $9.95

Kit Model TM-12. 5 tube 12 watt AC amplifier kit with push-pull 6V6 output. Inputs for V.R. cartridge, phono pickup and crystal or dynamic mike. Output to 8 ohm speaker. Shipping weight 10 lbs. TM-12 kit with tubes and diagram. $9.95.

ALUMINUM VOICE COIL REPLACEMENT SPEAKERS—FACTORY PRICES

McGee's Aluminum Voice Coil Double X Line. McGee offers you our Double X line of replacement P.M. Speakers. Made by a pioneer of the aluminum voice coil speakers. All of the Double X speakers have Alnico V magnets. All aluminum voice coils with RMA standard 3.2 ohm impedance. Why pay twice as much for a replacement speaker? McGee buys them by the carload and sells them for half price. Every speaker is unconditionally guaranteed.

Double X Aluminum Voice Coil, Alnico V Magnet, RMA 3.2 ohm V.C.

Stock No.					
4XX	4" square	1 Oz. Mag.	$ .99 ea.,	10 for	$ 9.50
5XX	5" round	1 Oz. Mag.	.99 ea.,	10 for	9.50
6XX	6" pincushion	1.47 Oz. Mag.	1.69 ea.,	10 for	14.95
6XX2	6" pincushion	2.15 Oz. Mag.	1.95 ea.,	10 for	17.95
46XX	4x6"	1 Oz. Mag.	1.49 ea.,	10 for	13.95
57XX	5x7" oval	1.47 Oz. Mag.	1.95 ea.,	10 for	17.95
7XX	7" pincushion (Auto set)	3.15 Oz. Mag.	2.79 ea.,	10 for	24.95
8XX	8" pincushion	3.16 Oz. Mag.	2.95 ea.,	10 for	27.95
69XX	6x9" oval	3.16 Oz. Mag.	2.95 ea.,	10 for	27.95

20-WATT AMP. KIT $14.95

TWO MIKE INPUTS PUSH-PULL 6L6's

Deluxe 20 watt public address amplifier kit with two wide range inputs, three tone bass boost tone control. Universal matching output transformer. Push-pull 6L6 and 12AX7 tubes is ready matched with matching output. Full 160 mill power transformer. Push-pull 6L6 output tubes. Separate electronic bass and treble tone. Inverse feedback. This amp kit will make up just like a factory built amp. Very easy to follow step by step. All parts and tubes furnished, as well as schematic diagrams and photos. Ship. wt. 20 lbs. Stock No. 20-20. Net $14.95.

30-WATT AMP. KIT $19.95 MAKES AN AMP. WORTH $40.00

Deluxe push-pull 30-35 watt public address amplifier kit. Same chassis and cover as used on the 20-20. This kit will give you 30-35 watts. This 30 watt amp will make up just like a factory built amp. All other features of 20-20 only gives full 30 watts output. Controls: Separate treble, bass, mike, phono and gain. Shipping weight 25 lbs. Stock No. 25-30. Net $19.95.

15 Inch, 50 Watt P.M. SPEAKER $15.95

Regular $45.00 List with wide range molded cone. Model 15-LS, or Alnico V Magnet PM Speaker. Will take 15 watts with ease. Thousands of dollars were spent in building the fine units to produce this speaker. The 8 ohm voice coil is 1½" in diameter and has been heat treated and plastic coated. Constructed to eliminate loose cone cuts, wires and rattles. Built by a renowned builder of fine speakers. Ship. wt. 14 lbs. Stock No. P15-LS. Net Price $15.95.

Two for $30.00

15 INCH JUKE BOX P.M. SPEAKER $9.95

Model 15-KB. Pre-War or Post-War, you never forget a speaker like this for such a steep price. Made by one of the world known builder of fine speakers. Full 15" 12½ oz. Alnico V magnet speaker of Juke box quality. Has standard 8 ohm voice coil. Will take up to 14 watts. Voice coil is 2" wide jack. Here is a speaker that will bring out those low notes. Latest 1948 production unit. Has been taken from factory stock or is guaranteed new and perfect. We may not be able to continue this offer for long at this price. Stock No. 15-KB. Net Price $9.95. POSTAGE: Wt. 10 lbs. A $35.00 value for only $9.95

50-WATT 12" SUPER HEAVY DUTY P.M. $13.95

Model A-50-12". 50 watt super heavy duty permanent magnet speaker. 12" x 2" thin treated cone and new gray treated cone. Heavy full range rubber surround. 2" voice coil, with felt washer. Edge mounted. Frame is of heavy construction and is metal pot cover. Finished in silver-gray enamel. This speaker is the most powerful 12" speaker made today. Inherently smooth in response and will bring out highs and lows in music that you never knew existed. Ideal for use in large auditoriums, dance halls, etc. Has a power handling capacity of 50 watts. Ideal for use in two or three unit systems. Recommended for use in the finest of outdoor speaker. Especially recommended for all public address systems and high quality home audio systems. Will handle 50 watts with ease, and 70 watts for short periods of time. Its retail value is $50. But, by a special purchase, we are able to offer it to you for only ..... $13.95. Do not confuse this speaker with surplus merchandise. This is the latest production. Model A-50. Shipping wt. 13 lbs.

COAXIAL 15 INCH P.M. SPEAKER

$60.00 SALE LIST PRICE $19.95

This 15 inch 25 watt peak, coaxial PM speaker is not surplus it is manufactured by a leading speaker company for our own specifications. We buy them by the hundreds in order to offer them to you at this low $19.95 price. They are regular $60.00 list. The 15 inch woofer will reproduce down to 30 cycles. It has a 32 oz. alnico V magnet and molded cone with 1½ inch voice coil. The 5 inch high frequency tweeter is coaxially built in with a spectacle cone that will produce notes up to 16,500 cycles. The input impedance is 8 ohms. Matching transformer mounted under the pot cover. Just hook to any 8 ohm output. 16 lbs. Stock No. P15-X. Sale price only $19.95.

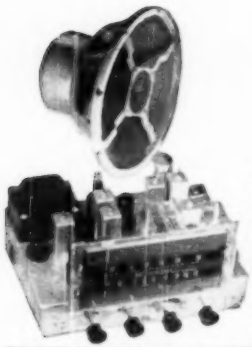
HIGH FIDELITY OUTPUT TRANS. 20—20,000 CPS ONLY . . . $6.95

A-401—6600 ohms. Plate to Plate. BEST VALUE IN U.S.A.

Why pay $25.00 or $30.00 for an output. Superior quality and high fidelity output transformer. Designed to match push-pull plate 5,000 ohms, or 2-6V6 class AB, to a 4-8-15-250 or 500 ohm, with 100% feedback. Housed in a compound filled case. (3x4½x5". Actual net weight 6 lbs. If you want the best quality from your audio system, order this transformer. Response essentially flat from 20 to 20,000 cycles. We have tried several high quality outputs in our lab and find this to be the best value. Even though your amplifier only puts out 10 or 15 watts, this is what you should have. Converting impedances, surrounded shock mounted. Stock No. 401. Shipping weight 8 lbs. Net $6.95

40-WATT OUTPUT "CAPEHART" HIGH FIDELITY $7.95

Stancor built for Capehart hi-fi. This finest output transformer for Capehart and Stromberg-Carlson. 40 watt capacity under-wound to increase high frequency response and decrease capacity losses. High inductance primaries for maximum low frequency response. Has 100% feedback and 4 ohm secondaries for use with 4 ohm voice coil speakers. Made to Capehart hi-fi specifications. Primary impedance 6,000 ohms plate to plate. Has 100% feedback and 4 ohm secondaries for use with 4 ohm voice coil speakers. Made to Capehart hi-fi specifications. Primary impedance 6,000 ohms plate to plate. Frequency response 20 to 20,000 cps within 1 db. Power rating 40 watts. Designed for push-pull 6L6 tubes. Primary has 5



hallicrafters

S-56 11-TUBE FM-AM CUSTOM CHASSIS

A REGULAR $110.00 VALUE AT McGEE FOR $59.95

Model S-56 Hallicrafters, 11 tube AM-FM radio receiver chassis for broadcast and FM 88 to 108 mc. Automatic frequency control on FM, holds the receiver in perfect tune. Picture correction on rear of chassis. Full range tone control with bass boost. Push-pull 6K6 tubes in audio system. Frequency response essentially flat, from 50 to 14,000 CPS. Wide vision accurately calibrated slide rule dial, with pre-selection on broadcast band. Output transformer matches any 8 ohm speaker. 4 antenna terminals, two for AM and two for FM. This is the best type of home radio that we know of today. Better get your order in early. Designed to be used in commercial radio setting in the $400 to $600 class. The regular dealers' net on this chassis is $110.00. However, a lucky purchase enables us to offer these brand new, factory carboned S-56 Hallicrafters chassis complete with tubes and operating instructions, at only $59.95 less speaker. Chassis size 12¾x10x7¾". Weight 23 lbs. Brand new factory carboned. Buy your S-56 with a wide range FM speaker. Pick your combination from the prices listed below and save.

S-56 Hallicrafters custom chassis with tubes and operating instructions and 12" CR-13X coaxial PM, $12.50 list speaker, ready to play as pictured above. Shipping weight 33 lbs. Net, $69.95.

S-56 Hallicrafters custom chassis with tubes and operating instructions and super 12" 21 oz. Alnico V FM speaker, ready to play. Shipping weight 38 lbs. Net, $69.95.

S-56 Hallicrafters custom chassis with tubes and operating instructions and 15" 21 oz. Alnico V FM speaker, ready to play. Shipping weight 45 lbs. Net, $73.95.

Order the VM-406 3-speed record changer, shown below at $33.21, or the General Instrument single speed changer at $12.95, with your S-56 Hallicrafters.

PRE-AMP for S-56 or S-59

$4.95

Dual purpose pre-amplifier for use with S-56 or S-59. Only 4 wires to connect. With this pre-amp you can convert set to operate either a G.E. variable reluctance pick-up or a crystal or dynamic mike, using your S-56 or S-59 a home P.A. system. Preamp Model PA-1. Size 3¼x4¾". Shipping weight 2 lbs. Net price, $4.95. Crystal mike and desk stand $4.95 extra.

WIRE RECORDER and 18-WATT P.A. SYSTEM

SALE PRICE **$69.95**

Three years of wire recording experience has led to the development of this outstanding wire recorder and public address system. Housed in an attractive portable case with hinged lid on the recorder compartment. Beautiful streamlined Storage compartment in back panel for mike and accessories. Size 13¾x11¾x14". A full 18 watt Hi Fi amplifier with P.P. 6V6 tubes in output stage and separate 6A8G eraser circuit. This new super circuit eliminates all the hum in wire recording. 12-inch Alnico V P.M. speaker. Extension speaker jacks. Mike input tone control. Equipped with one 50 gauge wire recorder playback mechanism that has 7½ rpm turntable and General Electric variable reluctance pick-up. You can record or play back from Record from mike. The play-back quality is the only of volume and good quality. This is also a top wire recorder. Unit is completely assembled and ready to operate. Furnished with 15 minute spool of recording wire. Extra recording wire 15 min., $1.19; 30 min., $1.79; 60 min., $2.79.

Model GE-18 Portable radio address system and wire recorder shipping weight 58 lbs. Net, $69.95.

Crystal Mike and Desk Stand $4.95 extra.

MUSICAL P.A. 24-WATT $54.95

McGee's wide range musical P.A. amplifier $54.95. Powerful 24 watt, wide range amplifier, housed in an attractive leatherette covered cabinet with tricolor cassette. Front, 12" super heavy duty Oxford curvilinear cone, 22 oz. Alnico V PM speaker. This speaker is used in others only on their highest priced amplifiers. Response 40 to 17,000 cps. 5 inputs, 2 for inputs of instruments or mikes, one for crystal pick-up. Tone compensation for G.E. variable reluctance pick-up. Push-pull 6L6 output tubes, with tone controls and inverse feedback. This amplifier may be used for two instruments or two mikes. It is the most versatile amplifier that we know of. Stock No. M34-24. Complete ready to operate. Weight 26 lbs. Net price, $54.95.

3-SPEED RECORD PLAYER KIT $16.95

New 3-speed portable record player kit, housed in the attractive carried portable case. Has 33⅓, 45 and 78 RPM plastic idler wheel. Has G.E. variable reluctance pick-up arm, with needles. Alnico V 5" PM speaker and all parts to complete kit, parts and tubes to build AC-DC type amplifier, with separate tone and volume controls. Model 14-K, complete with wiring instructions. Weight 16 lbs.

REGULAR $179.50 LIST PENTRON 1-HOUR TAPE RECORDER $79.95

ON SALE AT McGEE

Model T-5-0 Pentron portable tape recorder. Regular $179.50 list $120.00 dealers' net. McGee made a lucky purchase and passes on the saving to you. Only $79.95 net. Better standard type unit. Housed in an attractive portable case, with removable hinged lid. Powerful AC transformer type, with inputs for crystal or dynamic mike and phono pick-up. External speaker jack. May also be used as a low power P.A. system. Two track recording gives one hour of recording on one reel of magnetic recording tape. Best frequency response we have ever heard. Separate recording and playback heads. Complete with mike. Pentron Model T-5-0 tape recorder. Shipping weight 32 lbs. Sale price, $79.95. 7" reel of recording tape $2.70 extra.

VM-406 3-SPEED CHANGER $33.21

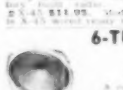
World's finest 3-speed all automatic record player, 33⅓, 78 and 45 RPM. Intermixes 10 and 12" records on 331/3 and 45 RPM. Priced complete with turntable, shipping weight 12 lbs. VM-406 Net $33.21. Model VM-407 furnished with G.E. variable reluctance pick-up arm and G.E. sapphire needle cartridges. Shipping weight 13 lbs. Net $37.95.

General Instrument automatic changer. Plays 12-10" or 10-12" records. Have 331/3, 45 and 78 RPM speeds. Complete record changer, ready to operate. Shipping weight 11 lbs. $12.95.

Build Your Own Radio Station Miniature Broadcast Station Kit $6.95

Kit Model BE-6K. Build your own 5-tube 6-volt AC-DC 4 tube miniature broadcast station. Has 115volt KC broadcast from crystal mike or phono record. Wiring. This transmitter may be used with only a short antenna or wire you will transmit 2 or 3 miles. Antenna coil for working indoor 4 to 6 stations. Weight 4 lbs. net $6.95.

McGEE OFFERS COMPLETE FACTORY ENGINEERED RADIO AND AMP KITS



GAROD PERSONAL PORTABLE KIT $11.95

with Batteries

KIT MODEL X-45 $11.95

Complete Garod Personal Portable Radio Kit Model X-45. Made from genuine Garod factory purchased radio parts, including the beautiful leather covered case. Has 4 tube superheterodyne circuit, with built-in loop antenna. Has 2 tube loudspeaker amplifier, all comes in which kit uses. Rugged metal case with colored plastic front and back. Full instructions are furnished with diagram and photos. Tubes and batteries are completely assembled and ready to operate. Furnished with 15 minute spool of recording wire. Extra recording wire 15 min., $1.19; 30 min., $1.79; 60 min., $2.79.

Model X-45, $11.95. Model X-45W, portable radio as X-45 with record player to operate set $14.95.

12-WATT AMP KIT FOR INSTRUMENTS MIKES OR PICKUP $14.95

General purpose public amplifier kit, housed in an attractive portable case, with 10" speaker. Two inputs for instruments or mike, one phono input. Variable tone control. Kit is complete with diagrams and photos and tubes.

2—12AT7, 6X4, 2—6AQ5. As illustrated top. Stock No. M-18BC, weight 20 lbs. Net $14.95.

Crystal mike and desk stand $4.95 extra.

ONLY $9.95 BUYS A 6-TUBE RADIO KIT

6 tube superhet. Uses 6BE6, 6BA6, 6AV6, 6AQ5, 6X4 tubes. Housed in a fine cabinet with slide rule dial, drum loop antenna and 5" speaker. This makes a factory like radio. The instructions are very complete and all sockets are installed. This type of kit usually sells for at least $15.00. Kit includes tubes 6BE6, 6BA6, 6AV6, 6AQ5, 6X4, 2—12AT7, 12SH7, 5Y3G and 5Z3. Complete with diagrams and instructions. Kit model PR-6. Wt. 8 lbs. $9.95.

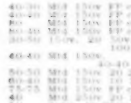
New 7-Way PORTABLE RADIO KIT ONLY $9.95

Sensational new 7 way portable radio kit. Comes in all aluminum battery operated case. Has built in loop antenna and 3" PM speaker. Will operate on Farnsworth, with loop antenna, Farnsworth with loop antenna and 3 ft. wire antenna, all mechanical bronze radio frequency coils, all mechanical bronze oscillator coils, all mechanical bronze antenna coils, all mechanical bronze trimmers, all mechanical bronze padders. Has 1R5, 1T4, 1S5, and 3V4 tubes, as well as 1 rectifier. You will make a full set every time you build. Has tone control. Set is powered by 2 standard flashlight batteries. Kit complete with tubes, batteries, speaker, cabinet, etc. Kit model PR-7. Wt. 8 lbs. $9.95. Batteries, 67½ volt, 45 cent; 1.5 volt, 25 cent. Total 1.25 extra.

6-TUBE AC 2 BAND RADIO KIT $9.95

BIGGEST RADIO KIT VALUE IN U. S.

BUILD A RADIO WITH MATCHED "DETROLA" PARTS



A complete kit of parts, tubes and ready punched chassis to build a fine 6 tube superheterodyne broadcast receiver. Has matched parts in every piece as well as a printed diagram and photograph. Chassis size 14 x 7½ x 7. Receives standard broadcast and 6 to 18 MC short wave band. 3 gang tuning condenser. Has 2 stage tuned radio frequency circuit. Uses no iron power transformer 6x6 output tube. This kit is made up of parts intended for use in a high quality Detrola radio. Has full vernier slide rule dial. Everything goes together just like a factory built radio. Priced complete with 6 tubes. Kit model 6-ACX. Less speaker. Weight 16 lbs. Net $9.95.

CHOICE OF EITHER 8 OR 10 INCH DYNAMIC SPEAKER, $1.99 EXTRA. NOTE OUTPUT TRANSFORMER IS ATTACHED TO THE SPEAKER.

McGEE'S NEW FM-AM-PA KIT $39.95

12 Tube Kit Model PHK-51. This is the most versatile radio, P.A. kit that our engineering department has ever developed. Has built in AM and FM tuners, with 3 tube AM tuner and FM 88 to 108 mc 3 tube tuner. Has 17 tubes in all. Has 20 watt amplifier, with response from 40 to 17,000 cps. 5 inputs, 2 for inputs of instruments or mikes, one for crystal pick-up. Has tone compensation for G.E. variable reluctance pick-up. Push-pull 6L6 output tubes. Has tone controls and inverse feedback. This amplifier may be used for two instruments or two mikes. It is the most versatile amplifier that we know of. Stock No. M34-24. Complete ready to operate. Weight 26 lbs. Net price, $54.95.

Complete with built in radio, P.A. system, a recording amplifier, or for a high fidelity FM-AM tuner. Has 2 speakers, 1 for P.A. and 1 for radio. Comes with the kit, including 1 each, 6AG7, 6SN7, 2-6BA6, RATE, 6H6, 6BE6, 2-12AT7, 2-6V6 and 5Y3. The FM IF section is ready wired coils and cements to make this kit super sensitive. Has built in beat frequency oscillator for CW reception. Has 6" PM speaker. Speaker terminals for 4, 8 and 500 ohm voice coils. Model PHK-51. Net $39.95. Wt. 12 lbs. $10.00 extra.

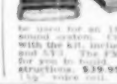
ALUMINUM CAN F.F. COND SOLAR CD—ETC. ORDER 50—TAKE 10% OFF

40-20	Mtd	150v	FP cond	1	.02	1	.29
40-40	Mtd	150v	FP cond	1	.02+.02	1	.29
80	Mtd	150v	FP cond	1	.02+.02	1	.29
80-40	Mtd	150v	FP cond	1	.02	1	.39
30-30		150v.	20	50v.			
				100	10v	11gwd	49
40-40	Mtd	150v.	20	25v	1	.02	39
			40-40	25v	11gwd		39
50-50	Mtd	150v.	20	25v	1	.02	39
60-40	Mtd	150v.	20	25v	1	.02	49
75-40	Mtd	150v.	20	25v	1	.02	49
40		Mtd	450v	20	25v	11gwd	19
50		Mtd	450v.	20	25v		
						1	.02
30		Mtd	150v	FP	cond	1	.02
24-10		Mtd	150v	FP	cond	1	.02
15-40		Mtd	150v	20	25v	1	.02

30-15	Mtd	150v	20	25v	1	.02	39
40	Mtd	450v	20	25v	1	.02	39
40-10	Mtd	450v	20	25v	1	.02	49
8	Mtd	450v	FP	cond	1	.02	19
10	Mtd	450v	FP	cond	1	.02	25
15	Mtd	450v	FP	cond	1	.02	34
24	Mtd	450v	FP	cond	1	.02	34
30	Mtd	450v	FP	cond	1	.02	39
40						25v	1
6-8	Mtd	450v	FP	cond	1	.02	39
10-15	Mtd	450v	FP	cond	1	.02	49
15-15	Mtd	450v	FP	cond	1	.02	59
20-15	Mtd	450v	20	25v	1	.02	59
30-15-10	Mtd	450v					
				20	25v	1	.02
20	Mtd	525v	FP	cond	1	.02	49

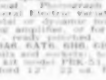
SALE

ST. GEORGE WIRE RECORDER MECHANISM $22.95



St. George wire recorder mechanism. Brand new complete wire recording and playback mechanism. Also plays 78 RPM records. Has 7½ RPM turntable and pick-up arm. Will record from radio, phono pick-up, mike, or from 1 hour or standard Webster wire. Furnished with diagram for simple converter so any radio or amplifier for wire recording. Has 3 speed motor, 110 volt AC. Complete with recording head, erasing head, and playback head. Net $22.95. Webster wire for playing back 1 hour, $2.25, or 30 min. $1.25. Webster wire, 60 min. $2.95, 30 min. $1.30. Crystal mike and desk stand, $4.95 extra.

WIRE RECORDER CONVERTER $12.95. With this 3-tube converter you can convert your St. George wire recorder mechanism to any radio or P.A. system. Only 3 connections necessary. Just plug in to radio or amplifier speaker jack and you have a complete wire recorder. All transformer construction, gain control, 3 position switch for quickly changing from record to play back. Uses 3 tubes, 12AT7 preamplifier, 6AQ5 Oscillator-eraser, 6X4 rectifier, 12AT7 preamplifier 6AQ5 Oscillator-eraser, 6X4 rectifier. Net, $12.95.



St. George wire recorder mechanism, brand new complete with 3 heads, 3 speed motor, 110 volt AC, 7½ RPM turntable and pick-up arm. Also plays 78 RPM records. Complete with recording head, erasing head, and playback head. Net price, $22.95. Webster wire for playing back 1 hour, $2.25, or 30 min. $1.25. Webster wire, 60 min. $2.95, 30 min. $1.30. Crystal mike and desk stand, $4.95 extra.

G.E. RPX010 V.R. CART. $2.95

G.E. RPX010, with new enamel needle. $2.95 each. 10 for $24.95.

A parts purchase by us enables us to offer the general electric cartridge listed above at a low price. Has G.E. variable reluctance pick-up. Has G.E. sapphire needle. Complete with instructions. Shipping weight 1 lb. Net price, $2.95.

Kit of parts to build 6BL7 type preamplifier, $2.49 extra.

Webster N-7, same as 1-41, L-70	$1.10
Astatic M1P-1, with needle	1.10
Astatic M1P-2, with needle	1.10
Astatic QT1-M, with needle	2.05
Astatic L-72	2.70
Astatic L-72 or Webster Equal	1.70
Astatic L-40 or Webster Equal	1.70
Astatic L-70 or Webster Equal	1.70

Take 10% off on 10 kit assortment.

600 VOLT PLASTICS

Molded plastic 600 volt by-pass condensers. Made to Solar specifications, etc. Guaranteed for one full year. Full quality. Assorted kit of .001, .002, .005, .01, .02, 10c each; .05 600 volt, 15c; 1 600v, 12c. Order 100 assorted and take 10% off.

600 VOLT BY-PASSES

Manufacturers' stock of replacement 600 volt tubular by-pass condensers. Best quality. Ideal for TV and A-C-D sets. They will take the heat.

.01	600 volt	.03	$0.07
.02	600 volt	.04	.08
.05	600 volt	.06	.12

100 assorted for $4.95

McGEE RADIO COMPANY

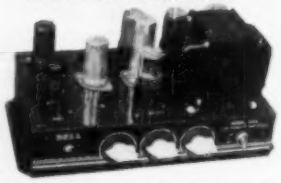
Prices F.O.B. K.C. Send 25% Deposit with Order. Balance C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER

1422 GRAND AVE., KANSAS CITY, MISSOURI

HARVEY has

BELL HI-FI AMPLIFIER



Medium priced, high fidelity, many important features. Inputs: Radio tuner, crystal pickup, 2 magnetic pickups (built-in preamp). Bass and treble controls, equalized inputs. Gain 74-110 db; output 10 watts; response ± ¾ db, 30 to 15,000 cycles.

Complete with tubes . . $41.70

Shpg. Wt. 15 lbs.

JIM LANSING SPEAKER

New 8" general purpose speaker for commercial and industrial systems. Aluminum ribbon voice coil, Alnico V magnet, 8 ohms impedance, power input 10 watts.

Shpg. Wt. 6 lbs. **$20.70**

FM TRANSLATOR
General Electric Model XFM-1

Covers 88-108 mc range, dial 12 inches long, power inputs for 110 to 250 volts, 50/60 cy. Quantity limited.

Special Price $49.50

BELL TAPE RECORD-O-fone

Record from mike, external radio or phonograph on dual track tape. Speaker or headphone monitoring while recording. Output can be connected to amplifier or PA system. Records on 5" reels with lid closed, also takes 7" reels for up to 1 hour recording.

Model shown, with built-in radio . . . . . $126.34 net
Same, less radio . . . . . 108.34 net

Shpg. Wt. 37 lbs.

NOTE: All prices are Net, F.O.B. N.Y.C. and are subject to change without notice.

Telephone: LUxemburg 2-1500

HARVEY RADIO COMPANY INC.

103 West 43rd St., New York 18, N. Y.

A Handy TV Service Kit

This efficient tool kit lends a "professional" air to your calls and speeds up TV servicing.

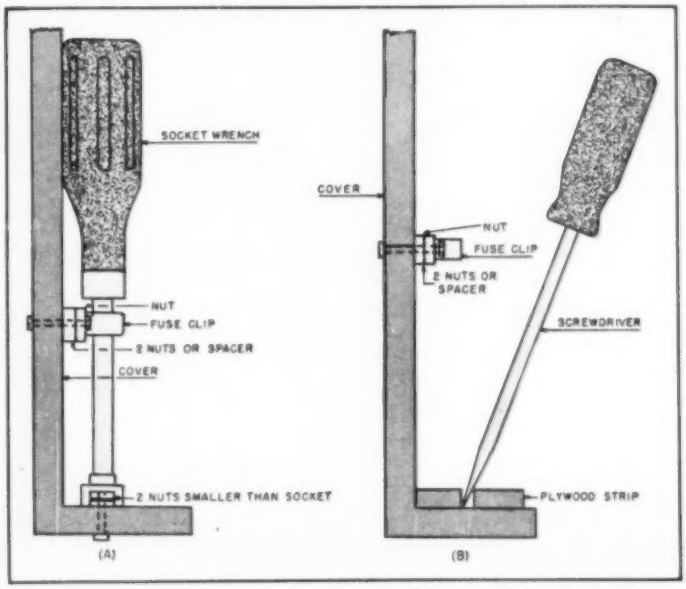
By
RALPH E. HAHN

Cover and tray layout of home-built kit.

BECAUSE the television technician who makes house calls is somewhat handicapped by the amount of service equipment he can conveniently carry around with him, and also by the lack of bench facilities, a neat and well designed service kit is essential to quick and efficient servicing in the home. A kit which contains enough tools and parts to repair most of the sets in the home will save many costly trips to the shop. It does not, however, need to contain "everything but the kitchen sink." A few well-chosen tools and parts will suffice for most jobs. The following is a description of a kit used by the author for a long time. Customers have made many favorable comments on the "nice looking tool box."

As may be seen by the photographs, the case is a portable record player cabinet. These cabinets can be obtained at any of the large radio supply houses. The one shown measures 19 x 14 x 8 inches. The exact size or shape is not important, however, as these dimensions may be varied to suit individual requirements. Perhaps no two service technicians will agree as to exactly what should be carried to the customer's home. However, the equipment listed under the suggested list of contents should meet the basic requirements of most TV men. This article may be used as a

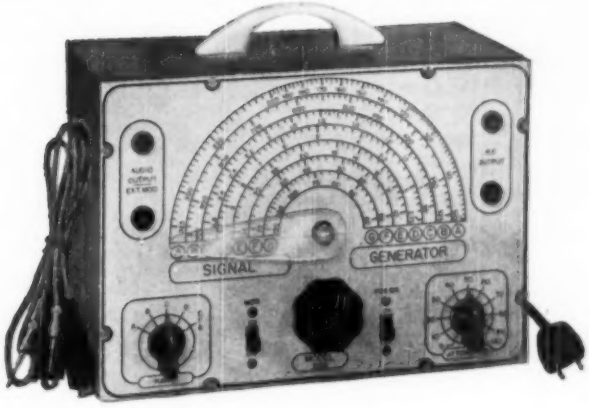
Fig. 1. Details for mounting service tools in the cover of the home-built kit.



WE KNOW THE PRICE IS UNBELIEVABLY LOW,

but that's not all! In addition, this finely engineered instrument provides a degree of accuracy never before attained in a unit selling for even double this price. Furthermore in designing this unit, we took advantage of every recent improvement in components. For example, by using slug-tuned coils, we are able to efficiently adjust each instrument for perfect accuracy. This feature will also enable you to recalibrate the model 200 periodically without having to return it to the factory. The use of a Noval tube (the 12AU7) with its extremely low inter-electrode capacity enabled us to reach a higher frequency range than was heretofore possible in a unit of this type.

THE NEW MODEL 200 AM and FM SIGNAL GENERATOR



SPECIFICATIONS

★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacycles.

★ **MODULATING FREQUENCY:** 400 Cycles. May be used for modulating the R. F. signal. Also available separately.

★ **ATTENUATION:** The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.

★ **OSCILLATORY CIRCUIT:** Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.

★ **ACCURACY:** Use of high-Q permeability tuned coils adjusted against 1/10th of 1% standards assures an accuracy of 1% on *all ranges from 100 Kilocycles to 10 Megacycles* and an accuracy of 2% on the higher frequencies.

★ **TUBES USED:** 12AU7—One section is used as oscillator and the second is modulated cathode follower. T-2 is used as modulator. 6C4 is used as rectifier.

The Model 200 operates on 110 volts A.C. Comes complete with output cable and operating instructions

$18.85 NET

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

GENERAL ELECTRONIC DISTRIBUTING CO. Dept. RN-1, 98 PARK PLACE NEW YORK 7, N. Y.

guide for making a new kit or improving your present tool box.

Because tubes cause the greatest number of television breakdowns, it is advisable to carry at least one of each of the types used in the makes of sets he services. The author carries about 45 TV tubes plus about 20 radio tubes. This may seem like a lot of tubes to lug around but as they are light they are not a burden and it pays off in fewer trips to the shop.

All tubes are placed "below deck" and are arranged into compartments according to size. If desired, these compartments may be subdivided into smaller ones and the tubes then segregated according to use, i.e., sweep, oscillator, rectifier, etc. This minimizes hunting for a particular tube. Partitions may be made of plywood, Masonite, or any similar material. They are held in place by cleats of the same material.

A removable tray is built to fit on top of the tube compartments. This tray is used to hold the meter, flashlight, etc. Partition it to fit your particular equipment. A coat of paint will improve its appearance. No handle is provided as it was found that the tray was easily removed by merely grasping one of the partitions. Glue a piece of sponge rubber on the bottom of the meter compartment also in the cover directly above the meter. This will hold it in place and cushion it at the same time.

Tools are mounted in the cover to facilitate easy removal and replacement. Also when they are spread out and mounted in an orderly fashion, a glance will tell whether anything is missing, thereby minimizing the possibility of leaving tools in the customer's home.

In mounting the socket wrenches and long screwdrivers, a very handy method is to use fuse clips to hold the shank while the bottom ends are held to the bottom of the cover. This is illustrated in Fig. 1. For the screwdrivers, a strip of plywood with holes

Arrangement of the kit's tube compartment.

that will just pass the end of each tool is used. A screw and two nuts which are slightly smaller than the socket are used to hold the socket wrenches. This method of mounting holds the tool in two places, yet it is easy to remove and replace with one hand. Place a nut or two between each fuse clip and the cover otherwise the handles will not permit the fuse clip to grasp the shank. For appearance sake, use screws with ornamental heads in mounting the fuse clips.

Small screwdrivers and the pliers are held in place with ordinary flat transmission line. Fasten the transmission line in place with thumbtacks or preferably, short woodscrews with washers.

Tacking in a kit of Allen wrenches completes the job. Avoid mounting any tools directly over the meter in order to provide enough clearance and prevent possible damage.

You now have a service kit which is both good looking and efficient, make the most of it by being neat and orderly when working in the customer's home. —30—

Suggested list of tools and tubes to be carried in this handy TV service kit.

One set of the following tubes:

1B3-GT/8016*	6BG6-G	6X5-GT
5U4-G	6C4	7B4
5V4-G	6F6-GT	7B5
5Y3-GT	6H6	7B6
6AC7/1852	6J8*	7F8
6AG5*	6K6-GT	7H7
6AH6	6SB7Y	7W7
6AK5	6SG7	7N7
6AL5	6SH7	12BA6
6AS7-G	6SL7-GT	12AT7*
6AT6	6SN7-GT*	12AU7
6AU6	6T8	12SN7-GT*
6BA6	6V6-GT	25L6-GT
6BE6	6Y6-G	25Z6-GT

Tools and Instruments

1—Multimeter, preferably 20,000 ohms/volt
1—Pencil-type soldering iron
1—Flashlight
1—Standard TV a.c. cord
1—Special a.c. cord (used on Stromberg-Carlson, some Philcos, Zenith, etc.)
1—Box 1/2 amp. fuses (Type 3AG)
1—Box 3 amp. fuses
1—Complete set of socket wrenches, 3/16" to 3/8"
1—Screwdriver, 4" blade, 1/4" tip
1—Screwdriver, 6" blade, 1/8" tip
1—Screwdriver, 6" blade, 3/16" tip
1—Screwdriver, 1 1/4" stubby, 1/4" tip
1—Short set-screwdriver
1—No. 1 Phillips screwdriver
1—Long nose pliers
1—Diagonal cutters
1—No. 6 Allen wrench, or
1—Complete set of small hex wrenches
Several small cardboard boxes to hold small parts such as test condensers, resistors, snap-in type coils, fuses, etc.
Various extension cords for audio, speaker, etc. These will vary depending on the types of sets serviced.

* Because the frequency of replacement of these tubes is quite high, it is advisable to carry at least two of each of these tubes.

TOPS IN PERFORMANCE

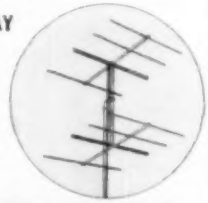
YAGI ARRAY

Here is the most sensational single channel performer. The YAGI array has achieved astounding results because in it Vee-D-X engineers have successfully combined every desirable feature for optimum performance. Compare what this YAGI offers you!

- Four element beam cut especially for each particular channel
- High forward gain and sharply directional
- Stepped-up driven element affords excellent match to 300 ohm transmission line. (Can also be supplied for 72 ohm match.)
- Exceptionally high front to back ratio helps reject unwanted signals
- Fabricated from highest quality 61 ST duraluminum (3/4" O.D. elements)
- Extremely light weight, easy to assemble, and neat appearing

STACKED ARRAY

To provide additional gain and improve signal to noise ratio on any one channel, two YAGIS can be stacked together. Also several arrays may be mounted on the same mast and directed to different transmitters.



VEE-D-X

VEE-D-X means video distance

LaPointe Plascomold Corp., Unionville, Conn.

Send new catalog and prices on the YAGI array and other Vee-D-X television accessories.

Name
Company
Street
City Zone State

EQUIPMENT SALE

	New	Used
BC-733D Receiver	$8.95	$3.95
RS9/ARN5 Receiver	8.95	3.95
APN1 Transceiver	9.95	4.95
SCR-518 Altimeter, complete	29.50	

R·H·S
SPECIALS OF THE MONTH

Sigma Sens. Relay SPDT	$1.69
200W Power Supply Kit	16.95
Tuning Unit TU-25	1.95
3" Scope Shield	1.49

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

1B21	$ 2.87	3EF1	$ 2.69	527A	$ 2.78	5J5	$ .29	CK601D	$ 1.95	6A8	$ .75
1B22	3.98	3E29	8.97	528A	3.95	5J6	4.10	CK507AX	1.95	6A10	.68
1B23	8.95	3EF7	1.75	550A	2.95	5J7	12.95	CK1005	.69	6A6	1.09
1B24	4.49	3GP1	6.75	550B	1.89	5K6	8.95	CK1006	.65	6A8F	.97
1B26	4.57	4-65A	10.49	551A	2.95	5K7	9.85	CK1007	3.95	6A8GT	.97
1B27	8.95	4-125A	27.45	553B	7.95	5K8	.39	EF50	.29	6AF6G	.79
1B29	3.49	4-250A	37.45	562A	1.95	5L6	1.98	F123A	12.75	6AG5	.77
1B32	2.98	4A110	4.75	562B	3.95	5M8	1.05	F125A	14.95	6AG7	.98
1B35	4.89	4B24	3.95	571B	.49	5R4	1.98	F127A	18.50	6AH6	1.29
1B38	26.50	4C35	19.50	586B	27.95	5T4	.39	F128A	75.00	6AJ5	.79
1B40	5.75	4E27	12.75	592A	1.39	5U4	1.39	F606	22.50	6AK5	.68
1B41	7.95	4J32	97.50	594A	2.95	5V4	1.25	F607	125.00	6AK6	.85
1N21B	1.65	5AF1	1.95	617A	9.95	5Y3	.29	F862A	450.00	6AL5	.68
1N23	.79	5AP4	1.95	624A	2.95	6A7	1.95	FG17	2.85	6AQ5	.69
1N23A	.79	5BP1	4.95	646A	1.25	6A8	1.39	FG27A	8.95	6AQ6	.89
1N23B	1.95	5BP4	2.69	650TH	17.95	6AB4	1.39	FG81A	3.85	6AT6	.67
1N34	.79	5CP1	1.69	652TH	37.50	6AC7	1.39	FG95	17.95	6AU6	.69
1P24	.79	5CP7	6.75	827	6.75	6AD7	2.95	FG105	9.75	6AV6	.67
1S21	3.95	5CP11	34.95	866	.98	6AE5	2.95	FG117	12.95	6AW6	.79
2AP1	3.69	5FP7	1.35	872A	12.49	6AF4	.79	FT210	13.95	6B4G	.89
2C21	.27	5GP1	8.95	931P1	3.98	6AG5	.85	GL446	9.95	6B6G	.89
2C22	.99	5JP1	39.50	700A/B/C/D		6AG7	1.19	GL807	2.69	6B8G	.89
2C26	.19	5JP2	9.95		19.95	6AH6	1.29	GL562	85.00	6BA6	.65
2C34	.27	5JP4	49.50	701A	2.95	6AK5	.68	GL807	99.50	6BE6	.67
2C40	4.59	5JP6	12.95	702A	2.75	6AL5	.49	HY115	.75	6BN6	.79
2C43	19.95	5JP7	12.95	705A	3.95	6AL7	.79	HY614	.98	6BQ6G	1.47
2C44	9.95	5LP1	13.95	705A	1.10	6AM6	.89	HYE114S	.37	6BR6	.67
2C47	8.95	5NP1	2.89	706B	18.95	6AQ5	.79	KC4	49.50	6BR8	.89
2C51	8.25	5RP1	2.89	706CY	28.75	6AQ6	.89	KR6010	9.75	6CB6	.79
2D21	1.17	6C21	19.69	706HY	47.50	6AT6	.67	ML100	49.50	6CL6	.87
2E22	1.29	6F4	5.59	707B	14.95	6AU6	.69	ML101	79.50	6CM6	.79
2E26	2.98	6J4	5.95	708A	3.95	6AV6	.67	ML501	69.50	6CS6	.69
2J21A	30.95	7BP7	4.65	713A	8.95	6AX4	.79	ML502	89.50	6CU6	.79
2J22	7.95	9JP1	6.95	714AY	4.95	6B4G	.89	RK34	1.29	6DC6	.67
2J26	7.95	10BP4	22.50	715B	6.95	6B6G	.89	RL11	4.85	6DE6	.69
2J27	13.95	10DP7	22.50	715C	22.50	6B8G	.89	REL34	.59	6DK6	.67
2J30	49.50	12DP7	12.50	717A	.50	6BA6	.65	REL36	.59	6DQ6	.85
2J31	9.75	12GP7	13.95	721A	2.69	6BE6	.67	RK23	3.65	6DT6	.67
2J32	12.95	12HP7	14.95	723A/B	2.75	6BN6	.79	RK25	.27	6EA8	.89
2J33	19.95	15E	1.29	724A/B	9.95	6BQ6G	1.47	RK30	.24	6EH7	.79
2J34	19.95	15R	.65	725A	6.95	6BR8	.89	RK59	1.95	6F4	.79
2J37	12.95	25D4	.30	726A	13.95	6BZ6	.79	RK63	18.95	6F5	.67
2J38	12.95	30	.87	730A	9.95	6C4	.59	RK65	34.50	6F6	.79
2J39	29.50	30 Spec.	.17	750TL	45.00	6C6	.67	RK72	.69	6F7	.79
2J40	49.50	45 Spec.	.26	800	1.75	6CB6	.79	RK73	.79	6J4	.59
2J45	49.50	50L6	3.49	801A	.79	6CD6	.79	RK37	8.75	6J5	.67
2J48	39.50	100B	1.85	802	4.25	6CL6	.87	RX120	3.95	6J6	.79
2J49	22.50	100TH	11.50	803	3.49	6CM6	.79	SS36	.89	2A4G	1.07
2J50	39.50	100TS	7.25	804	8.95	6CS6	.69	TZ40	2.95	2A5	.69
2J51	89.50	203A	57.50	805	7.95	6DE6	.69	VT501	2.95	2A6	.69
2J52	14.95	205B	1.78	807	1.10	6DK6	.67	VR65A	.98	2A7	.89
2J56B	39.50	211	.42	808	1.39	6DQ6	.85	VR75	.89	2V3G	.99
2J61	32.50	212E	.42	809	2.95	6DT6	.67	VR90	.89	5Y3G	.49
2J62	37.50	215C	9.95	810	7.95	6EA8	.89	VR105	.79	6A4	.67
2K25	23.95	218	47.50	811	2.10	6EH7	.79	VR105	.79	6A5	.67
2K26	14.95	221A	1.95	812	2.85	6F4	.79	VR150	2.95	6A6	.89
3AF1	4.85	222	2.70	812B	4.90	6F5	.67	VT127A	2.19	6A7	.89
3B22	2.69	227A	2.95	813	6.85	6F6	.79	VT158	14.95	6B4G	.89
3B24	1.89	231D	1.25	814	2.49	6F7	.79	VU111	.99	6B5	.89
3B25	4.87	242C	2.49	815	1.35	6J4	.59	WL446	6.95	6B6G	.89
3B26	1.79	246C	1.79	816	.97	6J5	.67	WL530	14.95	6B7	.79
3B27	3.85	250B	.45	826	.39	6J6	.79	WL531	7.95	6B8G	.89
3DP1	2.95	250TH	18.95	829B	7.45	6K6	.69	WL532	1.98	6T4	.89
3E25	2.47	250TL	10.75	830B	1.95	6K7	.69	WL534	1.98	6T8	.89
3E29	.37	274B	1.08	832A	4.89	6K8	.89	WL575	1.29	5V4G	.89
3E30	.34	304A	4.87	833A	34.45	6L6	.89	WL616	87.50	5W4	.79
3E32	3.95	304TH	5.75	834	5.75	6L7	.89	WL619	19.95	5Y3G	.49
3E45	12.95	304TL	1.39	836A	.97	6N6	.79	OA2	1.57	6Y3GT	.89
3EP1	1.49	305A	24.95	837	1.69	6N7	.89	OA4G	.95	6Y6G	.89
3EQ1A	1.95	307A	3.75	841	2.45	6Q7	.69	OB2	1.75	6Z3	.69
3DP1A	5.95	316A	.54	843	.35	6R7	.98	OD3	3.75	6Z4	.79

6Z5	$ .65	12A6	$ .65	25L6GT	$ .69	35Z5	$ .65	50	$ .90	80	$ .37
6Z7	.69	12AH7GT	.85	25W4	.69	35Z5GT	.65	50A5	.69	81	.37
6AB7	.79	12AT6	.65	25Y5	.69	35Z5GT	.65	50B5	.69	82	.37
6AC7	.79	12AU6	.67	25Z5	.69	35Z6GT	.65	50C5	.69	83	.69
6AF6G	.79	12BA6	.67	25Z6	.69	35Z6GT	.65	50L6GT	.89	83V	.89
6AG5	.77	12BE6	.67	25Z6GT	.69	36	.97	50X6	.89	84/6Z4	.63
6AG7	.98	12C8	.89	26	.87	37	.87	50Y6GT	.89	85	.69
6AH6	1.29	12J5GT	.69	27	.87	38	.87	75	.87	90V	.89
6AJ5	.79	12K7GT	.69	30	.87	38HP	.30	76	.87	117L7/M7	1.29
6AK5	.68	12K8GT	.89	31	.89	39/44	.27	77	.83	117N7	1.17
6AL5	.68	12Q7GT	.79	32	.89	41	.52	78	.89	117P7	1.27
6AL7GT	.97	12SA7	.98	33	.89	42	.69	80	.39	117Z3	.87
6AQ5	.69	12SC7	.89	34	.89	43	.69	1201	.89	1172G	.65
6AQ6	.89	12SF7	.89	35/51	.87	45	.69	1203	.89		
6AT6	.67	12SG7	.89	35A5	.69	46	.69	1204	.89		
6AU6	.69	12SH7	.89	35B5	.69	47	.69	1205	.89		
6AV6	.67	12SJ7	.89	35C5	.69	48	.69	1206	.89		
6AW6	.79	12SK7	.89	35L6GT	.69	49	.69	1207	.89		
6B4G	.89	12SL7GT	.89	35W4	.69	50	.69	1208	.89		
6B6G	.89	12SQ7	.89	35Y4	.69	50A5	.69	1209	.89		
6B8G	.89	14A7	.89	35Z3	.69	50B5	.69	1210	.89		
6BA6	.65	14B6	.89	35Z4GT	.65	50C5	.69	1211	.89		
6BE6	.67	14C7	.89	35Z5	.65	50L6GT	.89	1212	.89		
6BN6	.79	14E6	.89	35Z5GT	.65	50X6	.89	1213	.89		
6BQ6G	1.47	14F7	.89	35Z5GT	.65	50Y6GT	.89	1214	.89		
6BR8	.89	14Q7	.89	35Z6GT	.65	75	.87	1215	.89		
6BZ6	.79	14W7	.89	35Z6GT	.65	76	.87	1216	.89		
6C4	.59	14X7	.89	36	.97	77	.83	1217	.89		
6C6	.67	19/44	.27	37	.87	78	.89	1218	.89		
6CB6	.79	19T8	.89	38	.87	80	.39	1219	.89		
6CL6	.87	20P1	.89	38HP	.30	81	1.29	1220	.89		
6CM6	.79	20P3	.89	39/44	.27	82	.87	1221	.89		
6CS6	.69	20P4	.89	41	.52	83	.72	1222	.89		
6CU6	.79	20P5	.89	42	.69	83V	.89	1223	.89		
6DC6	.67	20P6	.89	43	.69	84/6Z4	.63	1224	.89		
6DE6	.69	20P7	.89	44	.69	85	.69	1225	.89		
6DK6	.67	20P8	.89	45	.69	90V	.89	1226	.89		
6DQ6	.85	20P9	.89	46	.69	117L7/M7	1.29	1227	.89		
6DT6	.67	20P10	.89	47	.69	117N7	1.17	1228	.89		
6EA8	.89	20P11	.89	48	.69	117P7	1.27	1229	.89		
6EH7	.79	20P12	.89	49	.69	1172Z3	.87	1230	.89		
6F4	.79	20P13	.89	50	.69	1172G	.65	1231	.89		
6F5	.67	20P14	.89	50A5	.69			1232	.89		
6F6	.79	20P15	.89	50B5	.69			1233	.89		
6F7	.79	20P16	.89	50C5	.69			1234	.89		
6J4	.59	20P17	.89	50L6GT	.89			1235	.89		
6J5	.67	20P18	.89	50X6	.89			1236	.89		
6J6	.79	20P19	.89	50Y6GT	.89			1237	.89		
6K6	.69	20P20	.89	75	.87			1238	.89		
6K7	.69	20P21	.89	76	.87			1239	.89		
6K8	.89	20P22	.89	77	.83			1240	.89		
6L6	.89	20P23	.89	78	.89			1241	.89		
6L7	.89	20P24	.89	80	.39			1242	.89		
6N6	.79	20P25	.89	81	1.29			1243	.89		
6N7	.89	20P26	.89	82	.87			1244	.89		
6Q7	.69	20P27	.89	83	.72			1245	.89		
6R7	.98	20P28	.89	83V	.89			1246	.89		
6S7	.79	20P29	.89	84/6Z4	.63			1247	.89		
6SA7	.89	20P30	.89	85	.69			1248	.89		
6SC7	.89	20P31	.89	90V	.89			1249	.89		
6SF7	.89	20P32	.89	117L7/M7	1.29			1250	.89		
6SG7	.89	20P33	.89	117N7	1.17			1251	.89		
6SH7	.89	20P34	.89	117P7	1.27			1252	.89		
6SJ7	.89	20P35	.89	1172Z3	.87			1253	.89		
6SK7	.89	20P36	.89	1172G	.65			1254	.89		
6SL7GT	.89	20P37	.89					1255	.89		
6SN7GT	.97	20P38	.89					1256	.89		
6SQ7	.89	20P39	.89					1257	.89		
6SR7	.89	20P40	.89					1258	.89		
6SS7	.89	20P41	.89					1259	.89		
6T8	.89	20P42	.89					1260	.89		
6U5/6G5	.79	20P43	.89					1261	.89		
6V6GT	.89	20P44	.89					1262	.89		
6W4GT	.89	20P45	.89					1263	.89		
6X4	.79	20P46	.89					1264	.89		
6X5GT	.79	20P47	.89					1265	.89		
6Y6G	.89	20P48	.89					1266	.89		
6Z3	.69	20P49	.89					1267	.89		
6Z4	.79	20P50	.89					1268	.89		

OIL CONDENSERS
ALL RATINGS DC

.25 mfd	600v	$ .37	1 mfd	2000v	$1.07		
.5 mfd	600v	.39	2 mfd	2000v	1.47		
1 mfd	600v	.47	4 mfd	2000v	2.97		
2 mfd	600v	.87	8 mfd	2000v	5.97		
2&2 mfd	600v	.77	15 mfd	2000v	9.95		
4 mfd	600v	.97	1 mfd	2500v	1.45		
6 mfd	600v	.97	25 mfd	2500v	7.77		
8 mfd	600v	1.07	.5 mfd	2500v	1.98		
10 mfd	600v	1.27	05 mfd	3000v	1.75		
.25 mfd	1000v	.37	1 mfd	3000v	2.65		
.5 mfd	1000v	.57	5 mfd	3000v	2.75		
1 mfd	1000v	.67	1 mfd	3000v	2.98		
2 mfd	1000v	.77	2 mfd	3000v	5.47		
4 mfd	1000v	1.37	4 mfd	3000v	6.45		
8 mfd	1000v	1.97	12 mfd	3000v	6.97		
10 mfd	1000v	2.07	1 mfd	4000v	4.25		
15 mfd	1000v	2.87	2 mfd	4000v	4.85		
20 mfd	1000v	3.27	4 mfd	4000v	5.45		
.5 mfd	1500v	.77	1 mfd	5000v	4.98		
1 mfd	1500v	.97	4 mfd	5000v	5.47		
2 mfd	1500v	1.37	.1 mfd	7500v	2.97		
4 mfd	1500v	1.97	1 mfd	7500v	5.97		
24 mfd	1500v	5.47	01 mfd	7500v	2.45		
1 mfd	2000v	1.07	05 mfd	7500v	2.97		
.25 mfd	2000v	1.17	03 mfd	7500v	2.97		
.5 mfd	2000v	1.27	1 mfd	7500v	6.95		
			02 mfd	12000v	9.97		

HIGH CAPACITY CONDENSERS
ALL RATINGS DC

2x3500 mfd	25v	$ 5.47	200 mfd	35v	$ .87
2500 mfd	3v	.35	100 mfd	50v	.45
3000 mfd	20v	2.45	4000 mfd	18v	1.95
2x1250 mfd	10v	1.27	4000 mfd	30v	3.25
1000 mfd	15v	.98	2350 mfd	24v	2.25
			10000 mfd	25v	4.57

TRANSFORMERS—115 V. 60 Cy.
HI-VOLTAGE INSULATION

3350v @ 1025 amps	$12.95
2500v @ 4 ma. 6.3v @ 1A; 2½v @ 2A	6.97
2500v @ 15 ma. $4.29 2100v @ 10 ma.	3.97
1700v @ 4 ma; 5v @ 1A; 5½v @ 2A	4.98
1500v @ 4 ma; 700v @ 150 ma; 2½v @ 5A	4.97
1500v @ 7 ma; 2.5v @ 1.75A	4.47
525-0-525v @ 50 ma. 525v @ 10 ma. 2x5v @ 3A; 6.3v @ 5A, 6.3v @ 2A; 6.3v @ 1A	6.97
400-0-500v @ 175 ma	4.95
450-0-450v @ 25 ma; 2624-0-2624v @ 5A ma; 6.3v @ 1A; 2x5v @ 2A	4.45
625-0-625v @ 75 ma; 5v @ 3A; 6.3v @ 1.5A; 400-315-0-400-315v @ 200 ma; 2.5v @ 2A; 5v @ 2A; 2x6.3v @ 5A	5.95
850-0-850-550v @ 200 ma; 2.5v @ 2A; 5v @ 3A; 2x6.3v @ 6A—pri 110/220	6.27
18-0-18v @ 70 ma. 2.5v @ 10A. 5v @ 6A. 5v @ 3A	4.95
340-0-340v @ 300 ma; 1540v @ 5 ma	4.95
600v CT @ 100 ma. 5v @ 2A. 12½v @ 2A; 12½v @ 1A	3.47
300-0-300v @ 65 ma; 2x5v @ 2A; 6.3v @ 2½A; 6.3v @ 1A	3.47
255-0-255v @ 240 ma; 525-0-525v @ 12 ma.	6.98
120-0-120v @ 50 ma	.97
940-50v @ 225 ma. 5v @ 2A; 5v @ 4 ma	3.49
50v @ 15A $9.95 24v @ 10A	4.47
15v @ 15A 5.95 13.5v CT @ 3.25A	2.47
12.6v CT @ 10A; 11½v CT @ 0.5A	6.97
12v CT @ 10A; 250V CT @ 10A	7.49
2x10.2v CT @ 7A	6.95
5v CT @ 1A	.97
6.3V @ 15A; 6.3v @ 2A; 2½v @ 2A	4.45
6.3v @ 12A; 6.3v @ 2A; 115v @ 1 amps	3.45
6.3v @ 10A; 6.3v @ 6A	2.47
5.2v CT @ 3.5A; 2x7.5v @ 3A	4.45
6.5v @ 8A; 6.5v @ 5A; 5v @ 3A; 2.5v @ 1.75A	4.45
6.3v @ 1A; 2.5v @ 2A $2.25 6.3v @ 1A	.77
5v @ 20A; 10KV ins. 9.97 6v @ 15 amps.	1.77
5v @ 2A; 2.5v @ 2A... 2.97 2.5 @ 10A	3.97

SELENIUM RECTIFIERS
Full Wave Bridge Type

INPUT		OUTPUT	
up to 18v AC	up to 12v DC	½ Amp.	$1.47
up to 28v AC	up to 12v DC	1 Amp.	1.97
up to 18v AC	up to 12v DC	5 Amp.	5.27
up to 18v AC	up to 12v DC	10 Amp.	8.97
up to 18v AC	up to 12v DC	15 Amp.	11.57
up to 18v AC	up to 12v DC	30 Amp.	22.57
up to 36v AC	up to 28v DC	1 Amp.	1.47
up to 36v AC	up to 28v DC	5 Amp.	8.57
up to 36v AC	up to 28v DC	10 Amp.	14.57
up to 36v AC	up to 28v DC	15 Amp.	22.27
up to 115v AC	up to 100v DC	.25 Amp.	2.57
up to 115v AC	up to 100v DC	.8 Amp.	5.27
up to 115v AC	up to 100v DC	5 Amp.	22.57
up to 115v AC	up to 100v DC	3 Amp.	17.97

FILTER CHOKES
HI-VOLTAGE INSULATION

10 hy @ 600 ma.	$ 5.97	1 hy @ 500 ma.	$14.97
15 hy @ 70 ma.	1.17	10 hy @ 250 ma.	3.97
10 hy @ 150 ma.	3.47	10 hy @ 200 ma.	3.96
50 hy @ 60 ma.	1.87	.0/20 hy @ 85 ma.	1.57
35 hy @ 15 amps.	7.97	15 hy @ 125 ma.	1.47
15 hy @ 5 amps.	6.97	15 hy @ 100 ma.	1.37
4 hy @ 600 ma.	6.97	2 hy @ 90 ma.	1.27
200 hy @ 10 ma.	3.47	30 hy dual @ 30 ma	1.47
600 hy @ 1 ma.	3.17	5/30 hy @ 250 ma.	3.47
325 hy @ 3 ma.	3.47	20 hy @ 175 ma.	3.99
2.5 hy @ 600 ma.	6.75	15 hy @ 40 ma.	6.75
6 hy @ 600 ma.	6.97	60 hy @ 50 ma.	6.97

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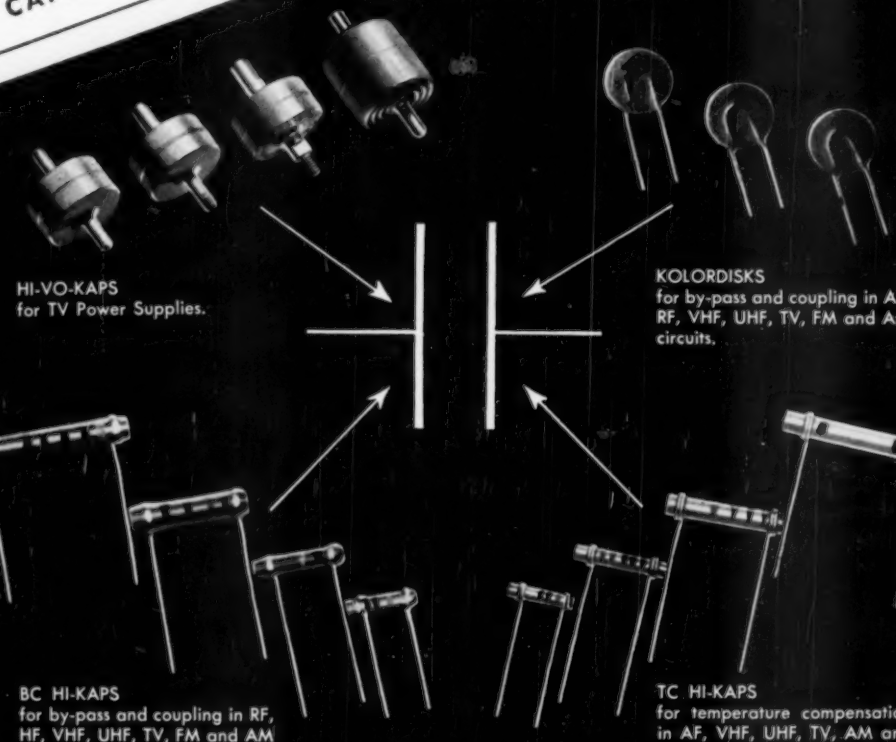

HI-VO-KAPS
for TV Power Supplies.

KOLORDISKS
for by-pass and coupling in AF, RF, VHF, UHF, TV, FM and AM circuits.

BC HI-KAPS
for by-pass and coupling in RF, HF, VHF, UHF, TV, FM and AM circuits.

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for temperature compensation in AF, VHF, UHF, TV, AM and FM circuits.

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WHEN YOU use high quality Centralab replacement capacitors in repairing radio sets, television receivers and other electronic equipment, you can be sure of customer satisfaction. You can be sure of new business. What's more, Centralab capacitors — *Hi-Vo-Kaps, Kolordisks, TC* and *BC Hi-Kaps* — make your job easier, save you time. Here's why. They're simple to install . . . easy to stock. Get all the facts on profit-making CRL replacement capacitors from your nearby Centralab distributor.

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A successful serviceman spoke recently of a plan he uses to get each new year off to a fresh, profitable start. Here are some of the questions he asks himself. "1) Do the replacement parts I use give my customers trouble-free service? 2) Are these parts designed to help me do a good job quickly? 3) Are they packaged to save shelf space . . . to make accurate selection easy? 4) Am I getting the kind of service I want from my distributor?" If you can answer "Yes" to all these questions, it's very likely you use quality Centralab parts, too. If you can't, we're confident you'll find it profitable to ask your nearest Centralab distributor for all the facts. Call him today!

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CRL

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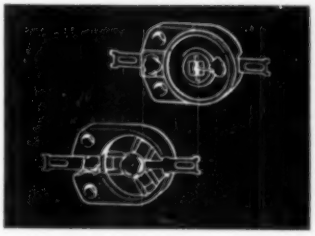

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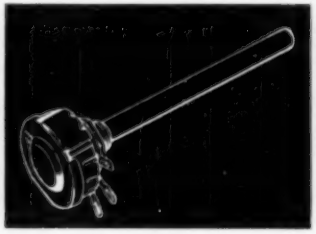
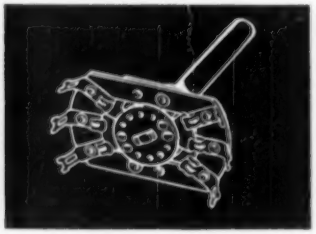
CERAMIC TRIMMERS for padder application in RF and HF circuits. These trimmers are noted for their great mechanical strength and electrical stability; low power factor. Hold circuit drift to a minimum. Truly an indispensable "must." Ideal for amateur, experimental and industrial use.



CONTROLS

MODEL "M" for voltage-divider, antenna shunt and "C" bias control, tone control, AF grid control. MODEL "I" for all miniature applications; rated at 1/10 watt, actually smaller than a dime. MODEL "R", wire wound, for voltage divider, antenna shunt, "C" bias, AF grid or tone control circuits.



SWITCHES

ROTARY for band change, meter, intercom circuits; made in ceramic and phenolic models. ROTARY SPRING RETURN for meter selection, intercom, phono-radio applications. MEDIUM DUTY for band changing in low power exciter-transmitters and receivers. LEVER ACTION for intercom, speaker, microphone and other applications.

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AFCA NEWS

This Association is a patriotic non-profit organization, with chapters in most of the larger cities, dedicated to developing and maintaining efficient personnel, commissioned, enlisted, civilian, for the supply (including design and development), installation, maintenance, and operation of communications and electronic equipment for Army, Navy, and Air Force and their supporting civilian activities. It publishes a magazine "SIGNALS" at its national headquarters in Washington. Every American interested in any way in communications is eligible and invited to join. Dues are $5.00 per year. Application should be submitted to the secretary at 1624 Eye St., N. W., Washington 6, D. C., who will furnish details upon request.

1950 Annual Meeting

Previously the dates and places of the annual meeting had been announced as New York and Fort Monmouth, April 26, 27 and 28. For a number of reasons, one being conflicts with Army maneuvers which might prevent certain tactical units from participating at Fort Monmouth, it was decided by the Executive Committee to change the dates to: Friday, May 12th —New York City: business meetings, panel discussions, conferences, luncheon, and banquet, plus a visit to the Photographic Center at Astoria, L. I. Saturday, May 13th—Fort Monmouth: exhibits and demonstrations of communications and photographic equipment and operations. The signal Corps, which is sponsoring the Fort Monmouth show, promises some events never before scheduled for any AFCA shows.

ROTC Prizes

Medals and other prizes are being awarded in 1949-50 to ROTC cadets who excel in leadership and electronics in Army, Navy, or Air Force Units. Awards will be made next spring at the following colleges which have qualified for participation: A & M College of Texas, Carnegie Institute of Technology, Cornell University, Georgia Institute of Technology, Iowa State College, Massachusetts Institute of Technology, Michigan State College, New York University, North Carolina State College of A & E, Ohio State University, Oklahoma A & M College, Oregon State College, Rensselaer Polytechnic Institute, Rutgers University, Southern Methodist University, State College of Washington, Texas Technological College, University of Alabama, University of California, University of Florida, University of Maine, University of Miami, Fla., University of Tennessee, University of Texas, University of Wisconsin, University of Wyoming, Virginia Polytechnic Instituate.

AFCA CHAPTER NOTES

Augusta-Camp Gordon

The October meeting was held at the Signal Corps Training Center Demonstrator, Camp Gordon on the 26th. Visitors introduced by President H. A. Fleming included Col. H. A. Vest, Communications Officer, Third Army; Col. Leroy, Executive Officer, Augusta Arsenal; and Capt. A. B. Gibson, the chapter's only life member, who was attending his first meeting with the chapter.

At the close of the business session, Capt. Claude E. Leslie, officer in charge of the Demonstrator Building, gave an account of the various uses to which the building is put, following which the equipment was demonstrated by the enlisted staff attached to the building. A short Signal Corps movie was also shown.

Baltimore

The *Chesapeake and Potomac Telephone Company* was host to the chapter for its November meeting. The members met for dinner at the company's Headquarters Building in Baltimore and then participated in the excellent program arranged by telephone company officials. Preparatory to a tour of the Headquarters Building, William E. Purdue, Plant Extensions Engineer, gave a talk on "Nationwide Toll Dialing." The group then inspected the equipment being installed which will tie Baltimore into the nationwide toll dialing layout. Other interesting exhibits included a cable splicer performing the intricate operation of splicing a telephone cable containing several hundred pairs of wires.

Chicago

The Chicago Chapter of the Armed Forces Communications Association held its October meeting at the *Hallicrafters Company's* Chicago plant on the evening of October 26th.

Chapter President Oliver Read presided at the meeting, while William J. Halligan welcomed the group in his dual capacity as host and as a national director of the AFCA.

After dinner Charles Honeywell, Television Engineer of *Hallicrafters*, gave a short talk summarizing the current important details of Color Television. He pointed out that two

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- INDUSTRIAL
- SPECIAL PURPOSE

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TYPE	PRICE EACH
0A4G	$0.95
0A	.45
1A5GT	.65
1B22	4.35
1B23	7.50
1B42	5.25
1C5GT	.65
1D8GT	.95
1E7GT	1.95
1E7G	1.95
1G6	.65
1L4	.75
1LC6	.75
1N5GT	.75
1N21 (Crystal Diode)	.65
1N21A (Crystal Diode)	.95
1N21B (Crystal Diode)	.95
1N22 (Crystal Diode)	.80
1N23 (Crystal Diode)	.80
1N23A (Crystal Diode)	.86
1N27 (Crystal Diode)	.88
1N29 (Crystal Diode)	.88
1Q5GT	.86
1R4/1294	.65
1S5	.70
1T4	.75
2A3	1.05
2A7	.85
2B7	.75
2B22/GL559	3.75
2B22/7193	.35
2B26	.35
2B26A	.45
2C34	.35
2J21A	11.45
2J22	9.85
2J26	8.45
2J27	12.95
2J31	9.85
2J32	14.85
2J33	18.95
2J34	17.50
2J37	13.85
2J38	6.95
2J48	12.95
2J51	27.50
2Y3G	1.20
2X2/879	.68
3A4	.36
3B22	2.65
3B24	1.75
3BP1	3.75
3C24/24G	.50
3D6/1299	.65
3E29	4.95
3FP7	2.95
3FP7A	4.95
3GP1	4.50
3HP7	2.95
3Q5	.90
3S4	.75
RFL-5	14.95
5AP1	3.95
5BP1	2.75
5BP4	3.95
5CP1	3.75
5DP1	24.75
5FP7	3.25
5GP1	4.95
5HP4	4.75
5J23	13.45
5J29	13.45
5R4GY	.95
6A4	.38
6A7	.38
6A8	.95
6A6	.75
6AB7	.95
6AC7	.90
6AK5	.80
6AK6	.80
6BA6	.95
6B7	.80
6B8	.95
6B8G	.65
6C4	.40
6C6	.70
6C21	19.25
6D6	.60
6E5	.70
6F6	.80
6F6G	.80
6H6	.45
6J5	.45
6J5GT	.45
6J6	.90
6J7GT	.70
6J8G	.95
6K6GT	.55
6L7	.75
6N7	.75
6R7G	.75

TYPE	PRICE EACH
6S7	$0.85
6S7GT	.70
6SF5	.65
6SG7	.85
6SH7	.40
6SJ7GT	.60
6SK7GT	.60
6SL7GT	.80
6SN7GT	.80
6SQ7GT	0.75
6SR7	.60
6S87	.60
6U7G	.85
6V6GT	.75
6Y6G	.75
7-11 Ballast	.35
7A4	.60
7A7	.60
7B4	.60
7C4/1203A	.40
7E6	.60
7F7	.70
7H7	.70
7K7	.70
7L7	.70
7N7	.70
7Q7	.60
10	.45
10T1 Ballast	.50
10Y	.45
12A6	.25
12A6GT	.25
12AH7GT	1.10
1208	.80
12F5GT	.65
12H6	.40
12J5GT	.40
12J7GT	.70
12K*	.65
12K7	.70
12SG7	.55
12SH7	.40
12SK7	.60
12SL7GT	.60
12SQ7GT	.60
12SR7	.60
12X525 - 2-amp. Tungar	2.10
13-4 Ballast	.35
14B6	.75
15R	1.20
REL-21	2.75
21D4 Ballast	.45
RK24	1.75
24A	.75
25Z6GT	.50
26	.65
27	.50
28D7	.40
30	.75
30 (VT-67) Walkie	.75
33 (VT-33) Talkie	.75
34	.35
RK-34	.45
35Y4	.65
36	.40
37	.40
38	.40
39/44	.40
43 Spec.	.50
46	.75
EF50/VT250	.45
56	.65
70L7	1.05
72	1.75
EKR-73	1.25
76	.85

TYPE	PRICE EACH
77	$0.50
VR-78	.65
80	.45
FG-81A	2.95
83V	.90
86Y	.60
VR-90	.65
VR-92	.65
100R	2.75
FG-105	0.75
VR-105	.65
VT-111-S	.55
1148	1.20
1173Z3	.55
VT-127 British	.35
VT-127-A (Triode)	2.95
VR-150	.80
VT-158	14.95
FG-172	10.75
205B	1.45
211 (VT4C)	.60
218A	1.75
221A	2.10
231D	1.20
268A	2.95
304TH	5.75
304TL	1.75
307A	4.25
316A	.75

TYPE	PRICE EACH
350B	$ 2.50
354C	14.98
371A	.86
371B	.86
388A	3.95
393A	4.65
395A	4.95
MX408U	.40
417A	14.50
434A	3.40
446A	1.50
450TH	17.98
471A	2.65
527	9.96
530	9.96
531	12.95
532A/1B32	3.85
GL-559	3.75
KU-610	7.45
HY-615	1.05
700B	7.95
700C	7.95
700D	7.95
702A	2.95
703A	3.95
704A	1.75
705A	2.65
707A	17.50
707B	19.50

TYPE	PRICE EACH
708A	$ 4.96
710A	2.45
713A	1.50
714AY	3.90
715B	9.75
717A	.98
721A	3.75
723AB	14.95
724A	4.25
724B	4.25
725A	9.95
726A	17.45
730A	10.95
801	.80
801A	.70
803	5.25
804	9.95
805	9.95
807	1.25
808	1.65
811	2.30
813	7.86
814	3.75
815	2.65
826	1.25
829B	4.95
830B	3.95
834	5.75
837	1.65

TYPE	PRICE EACH
838	$ 3.25
841	.50
843	.50
851	39.00
860	2.40
861	29.25
864	.45
865	2.55
866A	1.30
869	19.95
869B	27.75
872A	2.45
874	1.95
878	1.95
930 Photo Tube	1.00
954	.45
955	.55
956	.50
957	.45
959	.56
991 (NE-16)	.30
1005	.39
1148	.39
1201	.75
1204A 7C4	1.05
1616	1.25
1619	.45
1624	1.25
1625	.45
1626	.45
1629	.40
1631	3.95
1638	.90
1641 RK-60	.75
2051	.75
7193	.30
8011	2.25
8012	3.75
8020	3.25
8025	0.75
9001	.85
9002	.45
9003	.80
9004	.40
9005	.40
3B/111A	.45

NEON BULBS

NE-11	$0.24
NE-16	.24
NE-20	.06
NE-21	.24
NE-48	.24

PILOT AND FLASHLIGHT BULBS

STOCK NO.	MFR. NO.	VOLTS	WATTS	BULB	BASE	PRICE EACH
342-5	1256	6	21CP	S-8	DC Spec.	$0.05
350-41	943	6-8	100CP	G-18½	Auto Ser.	.10
354-76	1491	2.4	.8A	G-7	DC Bay.	.09
LB-260	86	115	6	S-6	Cand. Screw	.16
350-43	11A, T4C	18	.31A	T-4	Cand. Screw	.14
342-6	1245	6	3CP	G-6	SC Spec.	.08
LL-501	313	1	(Anode), metal housing, Amber Lens			.32
LB-202	328	24	"	T-1¾	Pressure Flange	.40
350-40	64	6-8	3CP	G-6	DC Bay.	.07
350-42	Spec.	12	6A.	S-6	Cand. Screw	.13
350-20	1446	12	2 amp.	G-3½	Min. Screw	.07
350-14	89	2	.06	T-3¼	Min. Bay.	.06
348-22	PR-10	6	.5 amp.	T-3¼	Min. Flange	.05
350-19	Prog. Bulb	120	500 W.	T-20	Med. Pf.	1.49
LB-17C	24B	24	4.05 a.	T-2	Tel. Base	.10
LB-58A	Nite Lite	110	7W	G-7	Cand. Bay.	.17
LB-57A	53	12-.6	1CP		Min. Bay.	.07
354-78	Airplane Headlite	24	239W	A-19	Med. Pf.	.30
350-55	323	3	(Aircraft)	T-1¾	953	.22
342-3	LM-60	115	250W	T-20	Med. Pf.	.40
LB-102	1195	12-16	80CP	RP-11	DC Bay.	.14
342-2	CC-13	110	100W	T-8	DC Pf.	.33
354-76	1491	2.4	.8A		DC Bay.	.14
354-77	302	28	(Airplane Type)		DC Bay.	.14
LB-106	313	28	.17A	T-3½	Min. Bay	.11
356-24	12A	12	05-.11A	T-2	Tel. Base	.10
LB-107	24-A2 WE	24	.75-.05A	T-2	Tel. Base	.16
350-63	All-1 Argon	105	2½W	S-14	Med. Screw	.22
LB-103	5122	Telephone Type Neon		T-2	Tel. Base	.17
356-18	1477	4	17	T-3	Min. Screw	.18

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MEISSNER SC FM Tuner with cabinet **$38.33**

MEISSNER SC FM Tuner less cabinet **34.33**

GENERAL ELECTRIC 1201 D Speaker **17.70**

UNIVERSITY 4401 Single Tweeter **12.00**

UNIVERSITY 4402 Dual Tweeter **24.00**

UNIVERSITY 4405 Filter Network **6.00**

BELL 2122 Amplifier **41.50**

BOGEN PH 10 Amplifier **29.25**

G. E. Preamp, self powered **9.57**

WEBSTER 356 27 Record Changer with GE Cartridges **39.75**

We will do all the necessary adaptation so that all you have to do is plug in and play after installation in your own cabinet. There is no charge for adaptation, except for extra wire, plugs, etc., which amounts to very little. When ordering please include sketch of layout and length of wire needed on each item. Allow one week for adaptation.

PICKERING MAGNETIC PHONO CARTRIDGES FOR THE ULTIMATE IN HI-FIDELITY RECORD REPRODUCTION

S-120 M. Sapphire, Standard Play **$9.90**

S-140 S. Sapphire, Long Play **15.00**

D-120 M. Diamond, Standard Play **24.90**

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R-150. Replaceable Stylus Cartridge, less stylus **9.90**

Standard Play Stylus for R-150 ..... **2.40**

PRESTO 15G 3-Speed 12" balanced turntable and motor. Professional quality for home use **$38.00**

REK-O-KUT LP-743, 3-Speed 12" Balanced Turntable and Motor **$49.50**

PARTS ASSORTMENTS

100 Ass't. Elec. and Tubular Cond. $3.49

100 Ass't. Resistors. 1.00

100 Ass't. Mica Cond. unmarked 1.00

25 Ass't. Pots 4.95

100 Octal Wafer Sockets 2.95

100 Octal Bakelite Sockets 3.95

PHONO ARMS

American model No. 1-1 with CR-1a 3.5 volt output cartridge. Unboxed. New $1.65

Astatic SL 8 and D 9 with L-29a cartridge. Standard replacement unit. Boxed. New $1.89

Phono arms less cartridge, but with all necessary hardware, straight or curved. Five (5) for $1.95

45 AND 78 RPM ADAPTER for 78 RPM record changers and manual players, converts any 78 RPM record player to a 3-speed player. Quickly attached and removed. Just slip on spindle. Only **$13.50**

RECORDING MOTOR AND TURNTABLE. Professional 33⅓ and 78 RPM with 16" aluminum alloy casting table, famous make. Reg. price $165.45. Brand new; reduced to **$116.00**

GONSET, 6 meter converter, easily converted to 10 meters, or use as is on 6. Reg. 39.95; reduced to **$27.95**

POTENTIOMETERS, 25 assorted, singles, duals, pads, etc. Some with switch **$3.95**

DUAL SPEED RECORD PLAYER. 78 and 33⅓ RPM, AC or DC in Portable brief-ette carrying case with 8" speaker and 3-tube amplifier. Heavy 12" table, adjustable speed motor, slightly used but reconditioned and guaranteed **$12.50**

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possible color systems are being considered, a *CBS* improved mechanical filter disc combination, and an *RCA* all electronic system. At public insistence, FCC hearings are being held to weigh the merits of each system.

An Army Signal Corps sound film entitled "Attack Signal (Electronics)" was viewed by the group. Arranged through the courtesy of Colonel Glen H. Palmer, Chief Signal Officer, Fifth Army, the film depicted the importance of "Walkie-Talkie" sets in assault operations.

Following the film, Harold Rensch, *Hallicrafters'* Project Engineer, gave a talk on Citizens Radio, the civilian equivalent of "Walkie-Talkie."

After the talks the meeting was adjourned to form convenient groups to tour the company's plant.

Cleveland

The first meeting of the 1949-50 season was held at the Coast Guard's Cleveland Lifeboat Station, Lake Erie, on October 13th. Bosn. W. H. Wilmot, commander of the station, greeted the chapter members in the station lounge. Lt. H. E. DeLong, Electronics Officer at Coast Guard headquarters in Cleveland, gave an interesting talk on "Electronics as Applied to Navigation." After a trip to the top of the tower to examine equipment used in these electronics aids, all hands were taken by small boat out into the lake to visit additional installations there.

Brig. Gen. S. H. Sherrill, AFCA Executive Director, who came on from Washington for the meeting, spoke informally to the group. He outlined progress made by the association and offered suggestions for increasing the membership of the chapter so that it might better carry out its mission of bringing together to their mutual benefit all the Army, Navy, Air Force, Marine, Coast Guard, and civilian personnel engaged in communications and photographic activities in the area.

The November meeting was conducted jointly with the local units of the AIEE and the IRE. The featured speaker was Dr. T. T. Goldsmith, Director of Research of the *DuMont Laboratories*.

Fort Monmouth

An intensive membership drive, organized by Col. T. J. Tully, former chapter president, has resulted in a 100% increase in chapter membership. Arrangements are also well under way for the AFCA 1950 annual convention which will be sponsored by both the Fort Monmouth and New York Chapters next spring.

Chapter officers were recently elected as follows: President—Col. James D. O'Connell; Vice-President—Lt. Col. W. R. Herrlein; Secretary—Maj. T. H. Giles; Treasurer—Miss Florence Adair.

Kentucky

The regular November meeting took place at the Phoenix Hotel in Lexington on November 10th. A stimulating talk on "Political Preparedness" by Dr. H. W. Hargreaves, Professor of Economics at the University of Kentucky, was the feature of the evening.

Philadelphia

Rear Admiral Earl E. Stone, former Chief of Naval Communications, was the guest speaker at a meeting sponsored jointly by AFCA's Philadelphia Chapter, the Franklin Institute, and the Institute of Aeronautical Sciences. The meeting was held at the Franklin Institute on November 2nd. Members and guests gathered at 6:30 p.m. in the Institute's dining hall. Among those at the head table were: Dr. H. B. Allen, Executive Vice-President of the Franklin Institute; Col. W. W. Watts, President of AFCA's Philadelphia Chapter; Rear Admiral Roscoe E. Schuirmann, Commander of the Fourth Naval District; Rear Admiral Earl E. Stone; Col. Albert Wolfe of the Institute of Aeronautical Sciences; Frederick R. Lack, National President of AFCA; Walter Evans, National Director of AFCA from Baltimore; and Brig. Gen. S. H. Sherrill, AFCA Executive Director.

Immediately after dinner, those present examined some of the splendid exhibits of the Franklin Institute and then gathered in the auditorium. Dr. Allen greeted the guests and introduced Col. Watts who presided at the meeting. After a brief outline of the objectives of AFCA and an expression of appreciation to the Franklin Institute, he introduced Admiral Stone, who was until recently Chief of Naval Communications and now has a special assignment with the Joint Chiefs of Staff in Washington. Admiral Stone explained in a most interesting and detailed manner, "Communications and Electronics—the Most Essential Tools of Joint Command."

A showing of the film, "Pro Patria Vigilans," the story of the Signal Corps' activities and accomplishments during World War II, concluded the program.

Pittsburgh

Dutch Henry's Restaurant in downtown Pittsburgh was the meeting-place of the chapter on October 11th. After dinner, Chapter President E. J. Staubitz of the *Blaw-Knox Co.* introduced Brig. Gen. S. H. Sherrill, AFCA Executive Director, who had come from Washington for the meeting. Gen. Sherrill outlined the progress made by AFCA since his talk to the founders of the chapter on an earlier visit in 1946 and stressed the fact that the main mission of the association is to bring communications, electronics, and photography personnel closer together in the three Armed Services and in industry.

Maj. A. L. Hall, Asst. PMS&T at Carnegie Institute of Technology, was present and indicated he expects considerable interest in the association and its award to the outstanding stu-

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dent at the college next spring. Past president Robert Disney spoke of his experiences in organizing the chapter; and Fred Moran, last year's president of the Baltimore Chapter, who has been transferred to Pittsburgh as superintendent of *Western Union* there, outlined the procedures used at Baltimore in making it one of the outstanding chapters.

Sacramento

An inspection and demonstration of California State Highway Patrol operations and communications featured the October 25th meeting of the Sacramento Chapter.

Seattle

Television was the topic of the October chapter meeting at the American Legion Hall. A brief summary of the subjects to be covered was given by Chapter President M. F. Kerr.

After a short film on television, showing relay stations, use of movie film in television, special event broadcasts and television studios in operation, Marshall James, entertainment chairman, introduced the guest speaker, Phil Hamlin of the *General Electric Supply Company*. Mr. Hamlin discussed types of television screens and advantages peculiar to each, grain of picture and size in relation to room size, use of color in television and the relative engineering problem.

The program concluded with a movie entitled, "Where Will You Hide?"—the answer being very aptly photographed that there is no hiding place in future wars.

Washington

The officers, directors, and committee chairmen of the chapter met on September 27th at the Raleigh Hotel to adopt a program for the current year. It was agreed to hold four meetings during the year—each of the first three to be sponsored by one of the services and the fourth to be sponsored by a local communications organization.

In line with this program, the first meeting was held at the U. S. Naval Academy in Annapolis on November 9th. After lunch at the Officers' Club, the members were conducted on an extensive tour of the U. S. Navy Communication Station. Capt. Richard E. Elliott, USN, in command of the station, welcomed the guests, and Comdr. Guy M. Neeley, Chief Engineer, Shore Communication System, described the various operations of the station. —30—

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QUITE often when soldering a tap on a close-spaced coil, the solder will stick on turns adjacent to the tapped turn. This excess solder may be easily removed by carefully heating the turns, and then quickly brushing with a small paint brush. It is advisable to cut about two-thirds of the bristle length from the brush in order to form a stiffer brush.....C. J. H.

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SIGNAL GENERATOR

Genuine Laboratory-type precision signal generator. Manufactured and sold for $68.00 each in large quantities during the war by Northeastern Engineering Corp., one of the top manufacturers of electronic equipment for the U. S. Gov't. Five fundamental bands starting at 150 K.C. Strong signals up to 120 M.C. Five step ladder type attenuator as well as potentiometer output control. Regular 1000 cycle audio oscillator using vacuum tube, not a cheap neon sawtooth audio oscillator. Audio output available separately. Weight without packing material 16 lbs. Complete with fused plug and coaxial output lead.

Super Special.. **$38.75**

NEW G. E. TRANSMITTER

Brand new General Electric BC-375 or BC-191 transmitters, export packed, absolutely complete and including complete set of spare tubes as well as 10 and 20 meter conversion instructions $100.00. BC-312, BC-348 or BC-224 receivers sold with the above transmitters (unit for unit)..... **$125.00**

SCR-610 portable 6, 12 and 24V crystal controlled transmitter receiver with built-in loud-speaker on receiver, complete **$59.95**

SCR-522 Transmitter-receiver in guaranteed condition complete with remote controls, antenna and mast.

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AC-DC POCKET TESTER

This analyzer, featuring a sensitive repulsion type meter housed in a bakelite case is the result of 15 years achievement in the instrument field by a large company specializing in electronic test equipment. Specifications of the AC-DC Model V-41 Ohammilliammeter: AC and DC Volts—0-25, 50, 125, 250 ... Milliamperes AC—0-50 ... Milliamperes DC—0-50 ... Ohms Full Scale—100,000, Ohms Center Scale—2400 ... Capacity—.05 to 15 Mfd. Total price, prepaid anywhere in the USA—**$7.00**. Similar DC Meter Leather AC operated range of above, **$5.50** prepaid.

STROMBERG CARLSON

Power Switching Relay Box. Neat 11½ x 4 x 5½" Steel case with light fitting cover, finished in beautiful crackle finish. **$1.00**

NEW G. E. SELSYNS

Sensational selsyns by G. E. Two or more controlled together work perfectly on 110V AC. Any rotation of the shaft of one selsyn and all others connected to it will rotate exactly in unison, even to the same direction. Useful for indicating direction of weather vanes, rotating directional antennas, or controlling many operations from a distance. Complete with diagram and instructions. Per Matched Pair..... **$4.95**

ISOLATION TRANSFORMERS $2.95

Many adjustments on radio and TV sets require that the chassis be grounded for successful results. Using an isolation transformer this can be done as routine procedure on every set on the test bench, eliminating the hazard of shock. Connected as auto transformers these isolation transformers can also be used to change 110V to 220V or the reverse. We do not believe that 100 watt 110V isolation transformers have ever before been offered at less than double our price of **$2.95**.

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$7.00 TAKES 'EM ALL

Aluminum Gear Box 18 x 8 x 7 contains 2 powerful electric motors and 2 matched gear trains, 62 gears in all, varying in size from ½ to 4" in diameter. Readily convertible to rotate a beam antenna or any other similar use. **$5.00**

Relay Box 730A Signal Corps Inter-connector Relay Box. This unit, made by Bell (BC-616) is aluminum case 6½ x 5½ x 2½, contains 1500ohm coil, condenser capacity, sensitive relays, terminal strips and terminal strips. Order several at this giveaway price of only **$1.95**.

Remote Control Aluminum case 4¼3x2 contains switch, 2 potentiometers, triple pole switch, 4 knobs, phone jack, and gear mechanism. Includes 8 prong JAN connector to fit box ... **$1.39**.

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Consists of 2 condensers and powdered iron core choke connected as filter network, to use in most juke boxes. Connects instantly between pick-up and amplifier **$2.00**

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ONLY **$19.95**

Equipped with ¼" Jacobs Geared Chuck and key. Not an intermittent duty drill, but a full sized rugged tool. Has 3 speed bolt-on universal gear handle. Precision-cut gears—bronze bushed motor—ball bearing thrust. Nothing under heaviest pressure because of powerful 1/10HP AC or DC motor and ball bearing thrust bearing. Other bearings self-aligning, lubricated-for-life type. Amazing powerful factory guarantee gives you 6 months trial at trouble-free use. Full refund (not just transportation) if not pleased with drill after trial.

274N COMMAND SET

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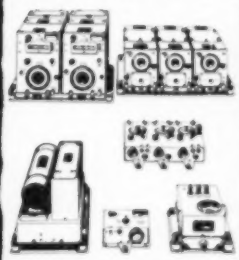

A mountain of valuable equipment that includes 3 separate Communications Receivers, covering up to 9.1MC. 2 separate 40 watt Transmitters including crystals, 4-28V Dynamotors easily converted to 110V AC operation. Pre-amplifier and Modulator. 2 Control Boxes, and 1 Antenna Coupling Box complete with R.F. Ammeter. 25 Tubes supplied in all. Receivers and Transmitters instantly detached from mounting racks for use in separate locations. Removed from ground aircraft set in guaranteed electrical condition. A super value at **$59.95** complete.

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SW-11—Single Pole, Single Throw ..35c
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SW-13—Double Pole, Double Throw ..57c
SW-14—Double Pole, Double Throw ..69c
SW-15—Spst, Double Throw, Center Off ..69c

POWER RHEOSTATS

Very rugged. Will withstand severe overloading to many times normal 25 watt rating. Without burning or smoking. 4 sizes, 50, 60 and 300 ohms. Reg. price $3.20. Special—**$1.00**.

BUFRAD SECTIONAL TOWER

This addition to the famous line of BUFRAD antenna products makes up to a hundred foot tower from any number of strongly welded ten foot sections, which are shipped assembled and painted. Erection is a matter of minutes, handily done by one man, and is accomplished by climbing up the completed portion of the tower with the next 25 lb section to be installed. Hand foot holds are provided for safety and ease. Cap at top of tower provides mounting and fed for rotating, and prevents water from entering tubes. Useful for police or amateur transmitting. In addition tower provides satisfactory TV reception where otherwise impossible. Ideal for supporting inverted V, commercial power lines, wind generators, electric public address speakers in spotlights for gas stations or parking lots, etc. Sections nest together and a total of **$15.75** and total 20 feet. "A" sections which make up the entire tower can be supplied for **$12.75** each. Mast base—foot shown in illustration—for only **$8.00**. Base is especially useful when starting tower on a sloping roof.

PORTABLE AIR COMPRESSOR $14.50

Portable air compressor and storage tank. Ruggedly built of heavy steel tubing and fittings. Equipped with heavy duty motor and compressor unit. Self-lubricating connecting rod and crankshaft integrated main bearing on shaft. Unloader valve relieves pressure on motor at start. Air cooled cylinder and head. Safety trouble. PATENTED piston or rotary system increases efficiency, reverse check valve prevents escape of air when motor stops. Delivers approximately 2500 cu. in. of air per minute at 40 lbs. pressure. Capacity of 50 lbs. Unit is complete with 100 lb. gauge. Finger-tip adjustment allows setting of output pressure at any value, which is automatically maintained. Works from any ½ H.P. motor. Useful for spraying paints or lacquers, inflating tires, etc. Ideal for use in tuning with natural gas, inflating tires, etc. Price **$14.50** prepaid anywhere in the U.S. Efficient, completely adjustable electric type spray gun complete with 12 ft. of 100 lb. tested hose available for only **$7.75** with gun container, also prepaid. C.O.D. required on all C.O.D. orders.

DELUXE AC-DC RADIO KIT

High quality standard production line radio in kit form with complete instructions. Features 2 gang condenser, 2 iron core I.F. transformers, and potting-less insulated edgewise-wound coils. Tubes 12Z3 ade 12AT6, 12BA6, 12BE6, 50B5 & 35W4. Receives broadcast band from 550 to 1700 KC. Kit form **$8.75** or 2 for **$17.00**. Assembled, wired and tested **$12.95** or 2 for **$25.00**.

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Type	Price	Type	Price	Type	Price
2A3	$ .95	12A6	$ .22	2051	$ .85
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6AC7	.65	24TB	1.95	RK73	.85
6SL7	.65	24YT	1.95	VR78	.35
6SN7	.65	446B	.85	VR105	.75
6Y6	.65	721A	2.95	C1A	2.95
7F8	.65	878	2.45	TaylorLVR	.45

New Surplus Relays

Following types are $.23 each
Any combination of 50 for $10.00

Allied No. 808050 Miniature type. Contacts—3 pole; 2-single-pole single-throw normally open, plus single-pole, double-throw. Wide spacing—high-voltage insulation, isolantite spacers. Coil 300 ohms, 28 volts, D.C.

Clare No. A-20545 Miniature type. Contacts—single-pole single-throw normally closed. Coil 45 ohms—6 volts, D.C.

GE B101W3. 170 ohm, 20 volts, D.C. Contacts—3 single make.

LEACH No. 1054. Coil 260 ohms, 24 volts, D.C. Heavy contacts, two pole single throw.

CLARE No. 818062. 2 pole single throw. Miniature type. Resistance 140 ohms. Will operate from 10 volts D.C. or 20 volts A.C.

TELEPHONE TYPE RELAY No. DR28091. Dual contacts, 4 P.S.T. Normally open Dual Winding Coil, 175 ohms and 180 ohms, 12 volts, D.C.

MINIATURE RELAY No. D4913 S.P.D.T. Coil 100 ohms, 24 volts, D.C.

STRUTHERS DUNN S.P.D.T. Relay 1800 ohm coil—20 ma. Contacts 2 amps. at 115 volts, A.C.

VACUUM RELAY

RCA VACUUM RELAY. Relay contacts will break 5000 volts and carry 10 amperes. Solenoid resistance, 200 ohms, 24 volts, D.C. Excellent at R.F. antenna relay. Price ..... **$.95**

TIME DELAY RELAYS

THERMAL VACUUM TYPE. S.P.S.T. 100 ohm coil. 24 volts A.C./D.C. 90 second delay. Price ..... **$.95**

WESTERN ELECTRIC No. KS10149. 60 second time delay relay. Cramer motor, 115 volts, 60 cycles. Switch S.P.S.T., 15 amps. May be internally adjusted for faster timing. Price **$4.95**

AC RELAYS

Allied type BJX. Operates on 6.3 volts A.C. Contacts SPDT. Small size. Price ..... **$.95**

STRUTHERS DUNN No. CS2366. Coil 110 volts, 60 cycles. DPST Contacts. 110 volts, A.C. 30 amps. Price Only **$2.95**

CASED A.C. RELAY ALLIED No. BJH 6A115. Coil 115 volts, 50/60 cycles, D.P.D.T. Contacts. Housed in hermetically sealed can with feed-thru glass-wire terminals. Price **$1.95**

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Precision Resistors

Types WW3, WW4, WW5

500,000	1%					$.65
100,000	1%					.55

Following sizes are $0.35 each; $27.50 100:

800,000	1%	220,000	2%	50,000	1%
700,000	1%	125,000	1%	25,000	1%
600,000	1%	109,000	1%		

Following sizes are $0.25 each; $19.50 100 most sizes are 1% or better—others 2%:

95,000	20,000	7,500	1,400	70
92,000	17,000	5,000	1,200	50
84,000	15,000	4,500	1,000	30
82,000	12,000	4,300	750	22
80,000	11,000	4,000	140	20
66,000	10,000	2,200	130	14
46,000	9,000	1,500	125	12
33,000				

Following sizes are $0.15 each; $12.50 100 odd types are 1% or better, round numbers are 3% or better:

.399 meg.	26,500	2,230	235	40
.268 meg.	22,000	1,123	110	35
109,000	20,820	988	70	30
54,500	17,300	280	80	6
50,000				

Following sizes are $0.10 each; $8.50 100 most sizes are 1% or better:

414.3	53.96	13.333	3.94	1.563
366.6	33.32	10.2	3.5	.29
220.4	33.22	8.1	2.58	.256
147.5	23.29	4.3	2.14	.25
105.8	13.52			

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LETTERS *from our readers*

"FAIR TRADE" AIN'T FAIR!

"RARELY do I read anything that makes me blind with rage. I am of a phlegmatic nature, but that article on fair (so-called) trading the prices of television sets made me feel like a Republican when low tariffs are mentioned.

"Do you remember 1946? OPA and price control? Industry propagandists hollered 'Loosen the chains from our great enterprising system! Sure prices will go up for a while, but the resulting volume of goods will soon bring on *competition* and competition will lower prices!' As far as I can remember, nothing was said about these nefarious un-fair trade laws.

"I went along with them about removing price controls. As a consumer I was apprehensive, but I put myself in the businessmen's shoes and agreed that I wouldn't want anyone telling me what I was going to charge for the articles that I made or sold. Let Freedom ring!

"Then comes Christensen with his Machiavellian article. Just about the time the industry has started to catch up, he says, 'Well, well, perhaps we were a little hasty about price controls. I believe we were wrong about that theory of free enterprise—freedom can go to excess too. Of course, we couldn't let government bureaucrats determine what prices should be, but our bureaucrats are of a higher order and their prices will *protect* us against the stern realities that we will have to face if open-field competition takes over. It was very naughty of the government to put a ceiling on prices but helping us to keep a floor under them is as virtuous as padlocking a bawdy house. Let Law and Order prevail!"

"Take that slick wording 'which is in open competition with commodities of the same general class produced by others.' Just look at the prices of refrigerators and toasters, if there is ½ per-cent difference in them I'll chew the chromium plating off a sample of each.

"About that poor department store that was complaining it would have to discontinue the sale of television sets. Well, isn't that a case of an inefficient business that must fall by the wayside to make room for a hustling organization? Competition must be with respect to prices and not with respect to screaming advertisements and slick-tongued salesmen.

"One of the main reasons that I am writing this letter is that I am one of those people that are not 'sold' any product. Why should I contribute to the support of some overpaid advertising copywriter and his ulcers or a flashily dressed salesman and his gardenia? Why can't I objectively and scientifically pick up the article I want to buy and pay the minimum price as set by unrestricted competition? Why?

"I hope that your magazine will take up the challenge and start a campaign against this latest threat to our free enterprise system."

Frederick R. Redwine
Chattanooga, Tenn.

* * *

NEW RECRUIT

"JUST a note to tell you how much I enjoyed the July issue of RADIO & TELEVISION NEWS.

"I quit buying it for awhile because the articles were way over my head. The article on the 'Beginning Amateur', is really tops for I appreciate any tips that are offered there, as I imagine other beginners do.

"At the present time I am trying to learn the code and learning it by myself is one heck of a job. If you print this letter I would appreciate it if any amateur in this city would contact me and tell me if there is a "ham" club around here."

Albert Baumgartner
423 Walnut Court
Jacksonville, Florida

Here's a chance to help Albert get his ticket and also garner some valuable points toward the prize in RADIO & TELEVISION NEWS' *big ham contest.*

* * *

OPEN LETTER

"THROUGH years of reading your magazine, I have found it to be an unbiased one. I was wondering if you couldn't give a helping hand to the radio technician by printing an open letter to the radio manufacturers that I have written. This message, you will find, is not unreasonable, but on the contrary makes a lot of sense to anyone in the rural districts unfortunate enough to be in the radio business today.

"We, the service technicians of the radio industry, have a good cause to gripe. We would like to know what is the matter with the radio manufacturers and why they let us down when the season for selling radios comes around.

"They announce, with great fanfare, the coming of the next line with the result that we try our best to sell them. Then what happens? They won't let us have any! They always have some poor excuse that does not make sense.

"When we have occasion to service these sets we have to wait for weeks for a replacement part.

"In other words, they are all so busy with television that they forget all

Your telephone uses ceramics, too!

Five thousand years ago, potters were making household vessels of clay. As skill grew, grace of shape and ornament were added. The beauty of fine china has been recognized by every civilization, while the availability, ease of manufacture and durability of other ceramics have given them wide use.

Your telephone, too, uses ceramics. Behind its dial is a metal plate, glazed as carefully and in much the same manner as this fine piece of pottery. It carries the letters and numbers you dial, so it must resist both fading and abrasion. You will find other ceramics as insulators, supporting wires on pole lines; in eighty thousand miles of underground conduit, where fired clays defy decay and corrosion.

Today at Bell Telephone Laboratories scientists utilize ceramics in ways undreamed of in ancient times. Thermistors, made of a ceramic, provide automatic controls for electric current, to offset fluctuations in temperature and voltage. One kind of ceramic makes low-loss insulation at high frequencies, while another supplies controlled attenuation for microwaves traveling in waveguides.

Each use demands a special composition, scientifically controlled and processed. Basic studies in the chemistry and physics of ceramics have shown how to utilize their versatile properties in electrical communication. And research continues on ceramic materials as well as on every other material which promises better and cheaper telephone service.

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For all 45 and 33⅓ rpm players. Highest compliance and 5 to 6 grams needle pressure give minimum wear on record and needle! Aluminum case—1-mil permanent sapphire needle.

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New superlight aluminum pickup complements famous original Titone pickup below. 15 grams needle pressure gives unparalleled reproduction, lowest wear!

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about radio, and all the rural areas that cannot possibly get television reception. We have come to the conclusion that they don't care about us at all.

"If we can't get radios to sell when the selling is good, how are we to make a living? If they would stop and think, we are the ones who keep them in business for the simple reason that if they had to service their own sets, they wouldn't have time to make any.

"Consequently when television does come, the people will look to the manufacturer who has given them good service, has supplied them with fine radios, and has been prompt in the delivery of replacement parts and radios to the proper outlet when they want them."

Paul B. Begin,
Rumford, Maine

* * *

SUGGESTION

"JUST a line or so to let you know how much I enjoy, and have enjoyed, your magazine for the past 12 years or longer. I have been in radio about that length of time and at present am employed as an electronic engineer at the United States Naval Academy at Annapolis.

"The purpose of this letter is to ask you about an idea that has occurred to me every time I use your magazine, which is quite often. I find it extremely helpful as a reference but am one of those unfortunate fellows with a short memory and can't remember in what issue I saw such-and-such an article.

"Last January 1st I made a resolution not to have this trouble again so as each issue came out I read it and then tore out the Table of Contents, punched three holes in it and put it in a loose-leaf notebook. This gives me an instant index to any article. In this way I have increased the value of the magazine 100 per-cent because I have made it a reference book rather than an occasional magazine.

"Why don't you folks publish an index (loose-leaf) with a binder which could be included with each mag for a few cents extra. Believe me, it would be a boon to us all, and the time saved would be worth many times the yearly price of the magazine.

"Yours for the continued success of a great magazine."

Joseph H. Griscom, Jr.
Eastport, Md.

We hope the yearly index, published in the December issue, is of help to Mr. Griscom. All articles are indexed as to subject matter.

* * *

IT WORKS FINE!

"I HAVE just renewed by subscription to RADIO & TELEVISION NEWS and thought I would write you a letter to let you know how much I like the wonderful magazine. I have been a reader of the "News" a long time and have gotten a lot of enjoyment out of every issue. Radio is only a hobby with me and I spend a lot of time with it.

"I have the October issue before me right now and have it opened to page 54 to the article on the construction of "A Low-Cost Ham Receiver." I have already constructed the set and find that it is all that it is said to be. I have made only one change in the set and that is that instead of using plug-in coils as in the article, I have used the coil changing assembly from a surplus BC 321 which I happened to have on hand. I still have a little work to do on the coil circuit and as soon as I get it finished I'll write up an article on this change and send it in to you.

"I find that many of the radio magazines nowadays are going too much towards television. I know that television is the coming thing but I don't see any reason why a magazine should devote all of its space to just television. There are a lot of radio bugs that are still interested in the construction of radio sets of all types. I notice that you have articles to suit all radiomen. I buy all the radio magazines at the newsstands but find yours the only one that I can get anything out of without getting too deep in technicalities. I am studying for a ticket so will soon be a ham and of course I will construct a transmitter from your magazine.

"I thought maybe you would like to hear from me and know how much I like the magazine. Please keep up the good work and let's have more construction articles on s.w. receivers. Will be looking for your swell articles from month to month."

Howard D. Thompson
Salem, Oregon

* * *

NECK STRETCHER

"THE November issue of RADIO & TELEVISION NEWS was purchased today and I enjoyed the articles very much.

"As I perused the pages my eyes fell on the cartoon by Russ Priestly at the lower right hand corner of page 116. The gentleman depicted seems to be enjoying the television program very much but I wonder if he objects very much to the projected video picture being upside down."

Donald F. Suppes, W2KDQ
Winchester, Mass.

If he doesn't now he will later!

—30—

"And, John, I think you oughta get your money back on that television set. I've been trying all day to get Bilton Merle, and all I can get is a picture of a green worm!"

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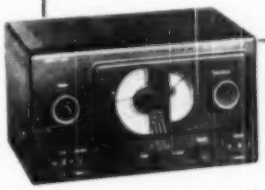

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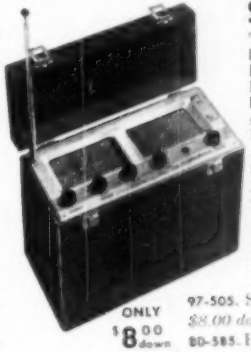

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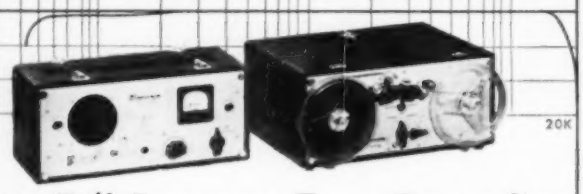

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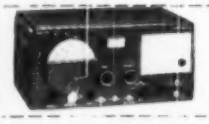

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Frequency Measurements

(Continued from page 35)

A difficulty will arise in making these tests if the receiver used has an i.f. frequency which is a multiple of 5 mc. The oscillator signal may be received directly by the i.f. stages. If this occurs the signal will persist, regardless of how the receiver dial is tuned. This difficulty may be overcome by realigning the i.f. stages to a slightly different frequency.

Signal Generator Method

Most signal generators used by radio service technicians will issue harmonics which fall in the FM broadcast band. Such generators, with the use of an auxiliary oscillator, can be used to mark frequency points in the citizens radio band.

To use this method, the signal generator should first be calibrated at a lower frequency either with WWV, or with its own crystal. The harmonics of this signal should then be tuned in on an FM broadcast receiver.

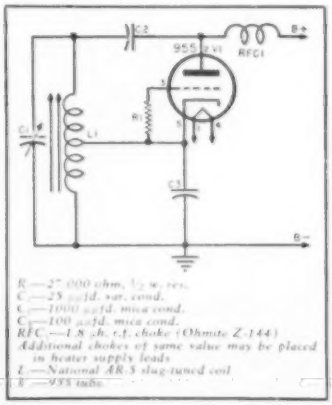
A simple oscillator, such as that shown in Fig. 2, can be constructed from an acorn tube and a *National* AR-5 slug-tuned coil or its equivalent. This oscillator will tune over a range which includes the FM broadcast band.

This oscillator can be aligned with the harmonic from the signal generator by the beat-frequency method, using the FM receiver to match the two signals.

The fifth harmonic of the signal from this oscillator will then fall in or about the 460-470 mc. band. A wavemeter or receiver which will receive the citizens frequency may then be calibrated by marking the harmonics as they appear.

A less accurate method calls for calibrating the test oscillator by zero-beating with an FM broadcast station rather than a signal generator and WWV. The result will be most accurate if the oscillator is checked during those brief moments when the FM car-

Fig. 2. Diagram of 89-120 mc. test oscillator.



R—27,000 ohms, ½ w. res.
C—25 μμfd. var. cond.
C—1000 μμfd. mica cond.
C—100 μμfd. mica cond.
RFC—1.8 *h.* r.f. choke (Ohmite Z-144)
Additional chokes of same value may be placed in heater supply leads
L—National AR-5 slug-tuned coil
V—955 tube.

rier is unmodulated at station breaks.

Ordinarily, the wide deviation of FM stations under modulation conditions will make it difficult to identify the center frequency of the station.

The FM band oscillator, regardless of the means used to check its fundamental frequency, should be equipped with a paper dial which can be marked for its harmonics. Three or more check points against the signal generator or FM station should be made. The fundamental frequencies of each of these points are then multiplied by five, and the result marked on the dial.

If FM stations are used as frequency standards, those transmitting on 91 to 94 megacycles will have harmonics in or near the citizens band.

While none will probably provide a check point at exactly 465 mc., the dial can be calibrated by interpolation between the known points. If a straight-line frequency condenser is not used in the oscillator, the scale will not be linear, and due allowance should be made for this fact when calibrating the oscillator. —30—

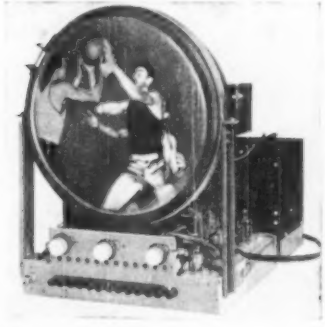
TRANSMISSION LINE CONNECTOR LOSSES

By MATTHEW MANDL

MOST television receivers use a 300-ohm twin-lead section from the tuner at the front of the chassis to the transmission line terminal posts at the back of the set. If any portion of this twin lead section touches the chassis or other metal parts of the receiver the result will be a pronounced decrease in signal strength. Even though this section of line does not actually touch the chassis, but runs parallel to it by one or two inches, it will affect reception, particularly on the higher channels where the shunt capacity effect would be greater.

After any servicing procedures involving chassis removal or other disturbance of this twin lead connecting link, it should be bent up and away from chassis and other metal parts. The soldered terminal connections at each end should also be checked, because the stranded wire of the twin-lead section often breaks at these points due to the constant movement this section undergoes during normal servicing procedures when the chassis is on the work bench. —30—

The antenna leadin (bottom right) should be held away from chassis to prevent losses.



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Shown using E-V Cardyne Cardioid Microphone in recording the Ituri pygmies in the Belgian Congo.

Write for Cardyne Bulletin No. 139

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Eliminating Broadcast Interference

(*Continued from page 52*)

tenna, however, a filter may still be necessary to prevent the horizontal frequency harmonics from finding their way up into the antenna and being radiated from this point.

The majority of better quality receivers with well-designed front ends have efficient high-pass filters and on such sets it will be found that disconnecting the antenna transmission line does not reduce the interference. Under these conditions, radiation is taking place either from the power line of the TV receiver or from the chassis itself or both. Bypassing both sides of the power line directly at the point where it enters the chassis with .001 μfd. condensers to ground will minimize power line radiation. Support the condensers on terminal strips and make the ground connections as short and direct as possible. If the interference still persists after this modification (and frankly, it usually does!), it is time to go to work on the TV chassis itself.

Remove the chassis from the cabinet and inspect the spring-like strap which makes contact between the chassis and the black aquadag coating on the bell of the picture tube. This coating, in conjunction with a similar coating on the inside of the bell, forms a capacity of approximately 500 μμfd, which helps filter the high-voltage applied to the picture tube. If the outer coating is not well grounded, it will act as an effective radiator for the horizontal frequency harmonics. Most receivers use one or more spring straps riveted to the chassis which make pressure contact to the bell of the picture tube when it is properly seated. These spring clips are sometimes unintentionally bent out of place when the picture tube is inserted in the chassis and the result is that the conductive coating on the bell of the tube is left floating. The remedy, of course, is to bend the springs so that firm contact is made to the bell of the tube.

If the bell of the tube is grounded, more drastic measures must be taken to eliminate radiation which can be taking place from anywhere in the horizontal output circuit. The horizontal output transformer, the horizontal output tube, and the damping tube are the "hottest" parts of the offending circuit and most TV set manufacturers provide partial or complete shielding of these components to suppress radiation. Heavy radiation also takes place from the face of the picture tube but obviously nothing can be done about this.

If the shielding is fairly complete, considerable radiation can still occur from the wiring in the horizontal output circuits, particularly between the deflection yoke around the neck of the tube and the horizontal and vertical output transformers. Such radiation can be suppressed by using shielded wire between the vertical and horizontal output transformers and the deflection yoke. It is necessary to shield both the vertical and horizontal leads since coupling can take place between the two windings in the yoke and result in radiation from the leads running to the vertical output transformer.

It will sometimes be found that resonant conditions are formed in the deflection yoke to output transformer wiring which peak the harmonics over a small portion of the broadcast band. This can best be cured by shielded wire or more simply by wrapping flexible metal braid around the existing wiring and grounding it securely to the chassis.

If shielding around the horizontal output circuit is skimpy, dress all external leads such as loudspeaker voice-coil connections, pilot lamp leads, etc., as far away as possible from this section of the chassis to prevent these leads from picking up and radiating harmonic energy.

Although incomplete shielding around the horizontal output circuit can be improved upon by fabrication and installation of makeshift shields made from copper screening, a more satisfactory solution consists of lining the inside of the TV cabinet with copper screening. If the chassis does not have a bottom plate, then copper screening on the inside bottom of the cabinet will nearly always be beneficial. It is usually easier to line the inside of the cabinet than it is to try to form and secure odd size shields around the various offending components.

Improving the signal-to-interference ratio at the broadcast receiver by a more efficient antenna is helpful in severe cases and often merely changing the location of the broadcast set by ten feet or so and orienting it slightly to take advantage of the directional properties of the loop will cut down the interference greatly. If the broadcast set uses an outside antenna make sure that the lead-in is dressed as far away as possible from the general vicinity of the TV receiver. Although the interference can often be reduced or eliminated by these and similar measures at the broadcast receiver, it is best to take all possible steps to reduce radiation at the TV receiver itself since it is the actual offender and the owner of an a.c.-d.c. broadcast midget may be loathe to make concessions for the "capitalistic" owner of a television set.

Fortunately, TV receiver manufacturers are now cognizant of the potential seriousness of this interference condition and most of the later model TV sets being produced incorporate improved design and shielding to minimize this condition. It still remains for the individual service technician, however, to use his native skill and ingenuity in overcoming interference created by existing sets and it is hoped that the suggestions offered in this article will serve as a starting point in such cases. —30—

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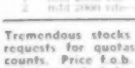

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.5	mfd 330 vac	.49	10	mfd 2000 vdc	8.95
1	mfd 600 vac	.29	2	mfd 4000 vdc	4.95
2	mfd 600 vac	.39	3	mfd 5000 vdc	4.50
4	mfd 600 vdc	.59	1	mfd 7500 vdc	2.25
8	mfd 600 vdc	.89	2	mfd 7500 vdc	3.95
3.3	mfd 600 vdc	.79	1	mfd 7500 vdc	9.25
10	mfd 600 vdc	.89	.01-.01 mfd 12 KV		
20	mfd 600 vdc	2.15		dc	6.75
4	mfd 1000 vdc	.95	.005-.01 mfd 12 KV		
6	mfd 1000 vdc	1.39		dc	6.50
2	mfd 1500 vdc	1.25	.05 mfd 12,500		
3	mfd 1500 vdc	1.49		vdc	12.95
1	mfd 1500 vdc	2.95	.25	Sinclair 2654	7.95
1	mfd 2000 vdc	1.45	2	mfd 15 KV dc	59.50
2	mfd 2000 vdc	2.25	1	mfd 15 KV dc	19.95

CERAMIC CASED MICAS

Type G4 Ceramic Case
5¾" High 5" Diameter
Tolerance 5% or Better

CAP MFD	Amps 1 Mc	Amps 300 Kc	KV DC	Price Each
.08	60	32	4	$50.50
.1	70	40	4	52.50
.05	60	42	5	27.50
.037	45	35	6	29.50
.02	40	30	9	32.50
.0117	45	27	14	27.50
.0075	39	27	15	27.50
.009	40	25	15	32.50
.00928	40	25	15	32.50
.01	45	25	15	34.50
.0225	23	15	20	32.50
.00318	28	18	20	35.50
.00411	27	18	20	34.50
.004	30	20	20	35.50
.0033	25	18	25	35.50
.00382	14	8	30	30.50
.001	16	10	30	31.50
.00132	20	12	30	32.50
.001375	21	12	30	33.50

TYPE G1 2½" High 2-1/16 DIAMETER

.004	16	11	6	4.95

BAKELITE CASED MICAS

MMF	VDC	Price	MMF	VDC	Price
D .001	600	$.18	D .005	5 KV	$ .70
E .01	600	.26	C .005	3 KV	1.24
D .02	600	.26	C .006	3 KV	1.50
D .027	600	.26	D .012	3 KV	.78
C .01	1 KV	.45	C .0001	5 KV	.70
C .026	1 KV	.50	C .00035	5 KV	.85
C .07	1 KV	.68	C .00115	5 KV	1.09
D .02	1200	.35	C .0015	5 KV	1.90
C .024	1500	.65	C .0045	5 KV	2.50
C .0033	1500	.75	D .007	5 KV	2.75
C .005	2 KV	.75	D .0032	6 KV	3.50
C .02	2 KV	.90	D .0033	6 KV	3.75
D .002	2500	.45	B .006	6 KV	4.25
E .005	2500	.55	D .00035	8 KV	2.90
C .0025	2500	1.25	D .0012	8 KV	3.25
C .001	5 KV	.90	D .0033	8 KV	4.75
C .002	5 KV	.90			

CONSTANT VOLTAGE TRANSF.

Thordarson. Pri. 95 to 135 plus 190 to 270 volts, 60 cycles. Output 115 volts, 150 VA ..... $29.75 ea.

W. W. POWER RHEOSTAT

25 Ohms 25 Watt	.49
150 Ohms 50 Watt	.59
250 Ohms 50 Watt	.59
500 Ohms 50 Watt	.59
Dual 200 Ohms 50 Watt	.79
8 Ohms 150 Watt	1.79

WARD LEONARD RHEOSTAT

25 ohms 675 watt. With knob.
Only ..... $3.95 ea.

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2"	WESTON 0-1 Ma DC 20 ohms res	$3.50
2"	GE 0-1 Ma DC (volt scale)	2.95
2"	GE 0-5 Ma DC (amp scale)	1.95
2"	GE 0-20 Volts DC 1000 ohm/v	2.50
2"	WESTON 150-0-150 Microamps DC	4.49
2"	GE 0-30 Amps DC	2.45
3"	GE 0-1 Amp RF (Internal Thermo)	2.45
3"	WESTINGHOUSE 0-2 Ma DC	3.95
3"	WESTERN ELECTRIC 0-80 Ma DC	2.95
3"	DEJUR 0-100 Ma DC	2.95
3"	GE 0-200 Ma DC	3.95
3"	WESTON 0-50 Amps AC	4.95
3"	TRIPLETT 75 Amps AC	3.95
3"	WESTINGHOUSE 0-20 Ma DC	3.95
2"	TRIPLETT 0-300 VAC	2.95
Meter Multip. 2 meg. 5% of 1% ea.		1.50

WESTERN ELECTRIC TRANSTAT Input 115 Volts 60 Cycles. Output continuously variable from 0-130 Volts. 10 Amps. 1.3 KVA ..... 15.45 ea.

Precision 15 Meg. 1% Accuracy Resistor, Non-inductive, 1 watt, hermetically sealed in glass 29c ea. 10 for $2.50

PLUG IN CAPACITOR

8 x 8 Mfd 600 volts DC. Oil filled. Plugs into standard 4 prong socket. 3½ h x 2½ w x 1¾ d $1.39

Thermat Time Delay Relay. 15 to 30 seconds, plugs into 4 Prong Tube Socket. Glass Enclosed. 250 V. ..... .95 ea.

Mallory Vibrapack Kit. 6 Volt Input. Output 300 Volts at 100 MA. Transformer & Vibrator ..... $5.95 for both

SUPREME MODEL 542 MULTI-METER

24 ranges. Meter sensitivity 5000 ohms per volt. 4 ranges for each of the following: 0 to 1500 volts DC, 300 microamps to 150 mills, 0 to 2 megohms, 0 to 600 volts AC, —6 to plus 50 DB, output 0 to 600 volts. OUR GREATEST VALUE. BRAND NEW $19.95

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.02 mfd 400 Volt JW Tubulars	15 for .99
GE 2 mfd 2500 Volt AC Condenser	6 for .99
10 ohm 10% Wirewound Resistor	.49
Heineman 6 amp 110V AC CB47 Breaker	.99
Heineman 25 amp 110V AC CB47 Breaker	1.49
Erie Ceramicon .0005 mfd	25 for .99
.01 600V DC Potted micros	15 for .99
.001 600V DC Potted micros	15 for .99
.004 600V DC Potted micros	12 for .99
Butterfly Coud. 2 to 12 mmf split brass	.49
CD type 4 .001 600VDC Micas	15 for .99
Hammarlund 250 mmf Variable, midget MC250M	.99
10,000 ohm Potentiometer	5 for .99
5½ meg Potentiometer	5 for .99
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Hammarlund 150 mmf Condenser, set spacing	.69
CD 8 mfd 450 volt Electrolytic in can, Dented But ok	5 for .99
3&1 mfd 1500V DC Oil Cond. for HC5550	.99
Centralab Variable Ceramicon 20 to 125 mmf	.29
Western Electric Silver Variable 5 to 25 mmf	.69
G.E. Outdoor Socket (weatherproof) 1N95F	.99
200-220-230 V AC	.99

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4 pole single throw	1.10
3 PDT plus 1 PST	1.75

G. E. SELENEUM RECTIFIER

32 volts input—out 24-28 volts 2 amps., full wave $1.75

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Input 110/220 volts AC DC. Output 80 volts at 75 mills plus 1.4 volts at 400 mills. Made for Army RC62 receiver. Complete with 1174.7 ..... $4.75

FILAMENT TRANSFORMER

Primary 110/220 volt 60 cycles. Secondary 5 volts at 15 Amps cased as illustrated. Great value at $1.99 ea.

50 megohm 35 watts IRC Resistor with mount. $1.45 ea. 10 for $9.50

ADJUSTABLE RESISTORS

20 Watt: 1, 5, 50 Ohms	.25
50 Watt: 80, 100, 500 Ohms	.35
75 Watt: 40, 80, 100, 150, 200 Ohms	.39
100 Watt: 20, 50, 75, 120, 180 Ohms	.49
150 Watt: 50, 100 Ohms	.59

1% PRECISION RESISTORS

2000-2500-5000-8500-10,000 ohms	ea. .25
50000-65000 ohms	ea. .29
10000-750000-1 meg	ea. .69

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Electrical reset 110V 60 Cy breaks at 640 ma but easily adjusted to other currents. Bargain at only 2.95

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10 for 4.99
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Industrial Instruments Model L2AU 110/220 volts 60 cycle input. Direct reading from 0-10000 megohms on 6" meter can be extended to 50000 megohms with external supply. Sloping hardware Cabinet 15 x8 x 10". Brand new with tubes plus running spare parts including extra tubes. Great value. Only $69.50

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Type MN Overcurrent Relay. Adjustable from 250 ma. to 1 amp. External Push Button Reset. Enclosed in glass case. Hand calibrated adjustments, only $5.95

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HIGH GAIN — 5 to 11 db. over a conventional dipole.

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HIGH SIGNAL - TO - NOISE RATIO — to eliminate interference.

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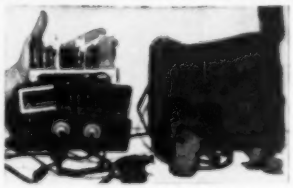
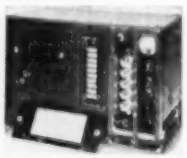
62 NEEDHAM STREET, NEWTON HIGHLANDS 61, MASSACHUSETTS

WHILE THEY LAST!



Navy "WALKIE-TALKIE" Model "M" series, 2.3 mc to 4.5 mc crystal controlled rec-transmitter. Ideal for hams, forest service, foreign, etc. Uses 7 peanut tubes and ordinary dry batteries that fit into same case. Weight less batteries, 6 lbs. With all tubes, mike, bracket, antenna, bag, diagram and 2 crystals. LIKE NEW, 2 for $18.00. Each $25.00



20 to 28 MC FM TRANSMITTER BC-604 for 11 & 15 meters; can be operated on 10 meters by use of proper crystal; 10 channel; with all tubes, meter, dynamotor, case and covers; less Mals and drawer.

U-1 with dynamotor $34.95 Without dyn $29.95
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PLUG, Cannon female fits into any of above FM sets. Does away with Mounting 13-527 ..... $2.45

GUN CAMERA type N-6 for 16 mm film, 35 mm f/3.5 lens, footage indicator, variable shutter Speed & aperture, 24VDC motor & magazine. Used, excellent $24.95

Postage extra. 25c charge on orders under $2.00. TERMS: Net cash. 25% deposit on C.O.D.'s.

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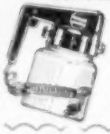
BURGESS VIBRO-SPRAYER



Just plug in and spray! No compressor or other extra equipment needed. Sprayer applies enamel, lacquer, varnish, shellac. Sprays light silk liquid wax, insecticide. Ab absolute "must" around any service shop, ham shack, home. At this low price you can't afford to be without one! Only $12.95 ea.

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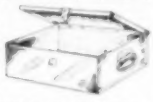

An extremely well-built steel box, hinged cover with two side carrying handles. Dimensions: 15" long, 12" wide, 6" deep. Finished in gray enamel. This light weight but rugged box is ideal for fishing tackle, tools, portable sets and dozens of other applications. Hard to beat at this low price of at any price ..... $1.45 each

BEAUTIFUL, 3½" G-E METERS

Round phenolic cases, brand new, cacked in original boxes. Here is real value:
0-15 V. AC. Check those ..... $2.95 ea.
Illuminite ..... $2.95 ea.
0-500 ma. Ideal for xmtrs ..... $2.95 ea.
100-0-100 ma. thermometer ..... $2.95 ea.
For Strikers ..... $2.95 ea.

MARKET SPECIALS!!

811 Tubes. New—not surplus ..... $2.95 ea.
Sealed, with plug wires, sealed ..... $4.95 ea.
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10x10 photos. Use on most xmtrs, recvrs $1.39
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P-T-T HIGH-QUALITY CARBON MIKE

Molded phenolic case, P-T-T button, cord terms, hi-quality W.E. F1 button. A mobile favorite at $3.95
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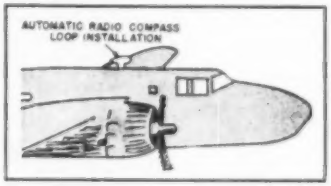
Aircraft Radio

(*Continued from page* 34)

Aircraft radio's future is tied up with aviation. If aviation rises or falls so will its electronic offspring.

Do not be deceived into thinking that aviation is the industry open to a chosen few booted and goggled supermen where everything is booming and everybody carries off a bucket of gold for his daily labors.

It is a new industry; in its short life it has had its share of depressing times when many employees were fur-



Showing the positioning of the radio compass loop in relation to the fuselage.

loughed. In the years since the war most of the companies have lost money. Those that survived are beginning to get into the black and show signs of an upward trend.

What can be definitely stated is that aviation is a young industry and that aviation is here to stay.

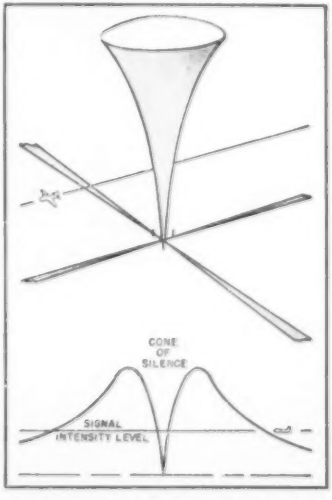
There is a tremendous amount of wealth, both government and private, invested in aviation.

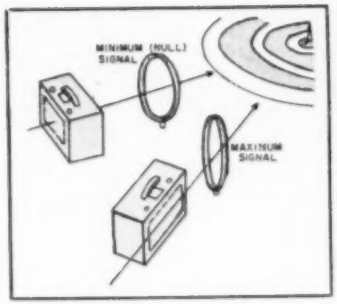
In spite of all its fine achievements aircraft radio has its shortcomings; it still has vast room for improvement.

Much of aviation's future is dependent upon the advancement of electronics.

The administrator of Civil Aeronau-

How a radio signal is used to "home" a plane during adverse weather conditions.





Loop position characteristics.

ties, D. W. Rentzel, recently made the following statement:

"The most urgent need of aviation today—civil and military—is a reliable, all-weather navigation and landing system. . . . The United States already has approximately six billion dollars invested in civil airports. Because of weather these airports are closed fifteen per-cent of the time. . . . The gravity of this situation, which is a bottleneck to commercial aviation and a weak link in our national defense, has been recognized in every group which has studied air transportation problems. Both the President's Air Policy Commission report and the report of the Congressional Aviation Policy Board emphasize the need for a safe, efficient, all-weather navigation system, estimated at one hundred million dollars to implement and requiring fifteen years—until 1963—to be placed in operation. This represents about five per-cent of our present investment in aviation in the United States. . . . The system must accomplish a task of almost fantastic complexity. Before the war, such a system could not have been established. But new developments, such as radar and other electronic devices using extremely high frequencies, have given us the tools which make such a system possible."

—30—

"I wish you wouldn't watch those bowling matches, Sam, they make you so nervous."

LET THIS "AUTOMATIC TEACHER" show you exactly how to repair over 4800 RADIO MODELS without expensive test equipment!

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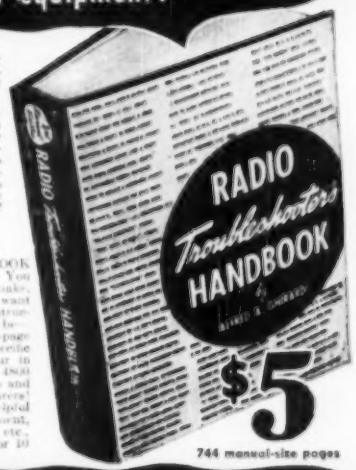

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Gives complete information on all essential service instrument types; how they work (with wiring diagrams); when and why to use them; how to build your own; preliminary trouble checks; circuit and parts analyses; parts repair, replacement, substitution; obscure radio troubles; aligning and neutralizing; interference reduction—and hundreds of other subjects including How to Start and Operate a Successful Radio Electronic Service Business. 723 self-testing review questions help you check your progress EVERY STEP OF THE WAY. Only $5 complete ($5.50 foreign).

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ARC-5 RECEIVERS: complete with all tubes, used, excel. cond.
19- 55 Mcs., 55 Kc. IF. Ea. ..... $ 9.95
3-6 Mcs., 705 Kc. IF. Ea. 3.95
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APN-1 ALTIMETER-TRANSCEIVER: Operates approx. 420 Mcs. FM designed to give accurate height above ground. Unit can be revamped for the 420 Mcs. ham or foundation for citizen's band. Contains 2-955, 2-9001, 5-12SH7, 2-12SN7. A dynamic vibrating capacitant for producing an FM signal, many other useful parts. (Makes excel. unit for FM or TV sweep generator.) Excel. cond. $3.95

ANTENNA RELAY, BC-442 OR RE-2, ARC-5: a 0-10 amp. RF thermo-couple meter. 50 mmf, 5,000 V vacuum condenser. Antenna switching relay. Used, excellent cond. Ea. $1.75

RS ARN-7 ADF COMPASS RECEIVER: covers from 100-1750 Kcs. Ideal for hi-fi broadcast tuner or receiver. Excellent cond. Ea. $15.95

APQ-5 POWER SUPPLY: Electronically controlled power. Embraces 2-5Y4G, 4-6V6, 2-VR150, 1-6H17, 1-6X5. Operates from 115 V, 400 cycle. Replacing xformer with 60 cycle. Makes ideal lab or test supply. Excellent cond. Ea. $4.95

METERS—ALL TYPES: from .5 Ma. to 300 Amps. from 0-10,000 V, 2-3 inch. Write for info.

FL-8 FILTERS, the lazy Q5er. Ea. $1.39

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2x8 mfd, 600 V ..... Ea. $0.89
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SPECIAL: 2 mfd, 150 V, paper ..... Ea. .10

2 V-WILLARD WET CELL BATTERIES: No. 20-2, Brand new, individually boxed.
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Order 2 for only 1.69

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SPECIAL TUBE REPLACEMENT KIT: for AC-DC Receivers, 12SA7, 12SK7, 12SQ7, 35Z5, 50L6. Each Kit $2.50

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Dynaural Preamplifier

(*Continued from page 57*)

that is present on the records cleanly and without distortion.

The "Dynaural" preamplifier is equipped with a range control (*S*$_1$) providing three positions, one wide open for the best recordings, another slightly restricted for average recordings and the third with a suitable restriction for early recordings. This allows elimination of "rattles" and other distortion without sacrificing any of the usable range. Because of the relatively low impedance of the circuit this range control is mounted on a cable for remote control.

The load resistance on the phonograph pickup should be in accordance with the manufacturers' specifications for correct high-frequency response.

Naturally an auxiliary unit like the "Dynaural" preamplifier requires maximum flexibility and compactness to facilitate mounting in practically any type of installation.

Figs. 1 and 2 show the general appearance of a factory-built unit with the controls as regularly supplied mounted on a separate panel. The small chassis can be mounted in a radio cabinet or other convenient location, as shown in Fig. 1. The small control panel can be mounted practically anywhere, such as in the record changer compartment, in extra record storage space, or on the main panel of the associated equipment.

The many convenient features of the "Dynaural" preamplifier, in addition to its performance, make it a natural choice for all high-grade installations where purchase of a complete "Dynaural" noise suppressor amplifier [2] is not warranted.

REFERENCES

[1] *Scott, H. H.: "Dynamic Suppression of Phonograph Record Noise," Electronics, Dec., 1946, pages 92-95. (Also 1946 edition of Proceedings of the National Electronics Conference.)*

———: "Dynamic Noise Supressor," Electronics, Dec., 1947, pages 96-101. (Also 1947 edition of Proceedings of the National Electronics Conference.)

———: "Dynamic Noise Suppressors and Recordings" FM and Television, Oct., 1946, pages 27, 60, 63.

[2] *Scott, H. H. & Dyett, E. G., Jr.: "An Amplifier and Noise Suppressor Unit," FM and Television, Mar., 1948.*

—30—

Oscillator and Gain Set

(*Continued from page 68*)

gain runs with such equipment is simple and well-known, a few suggestions are offered for those who have not had occasion to make such runs.

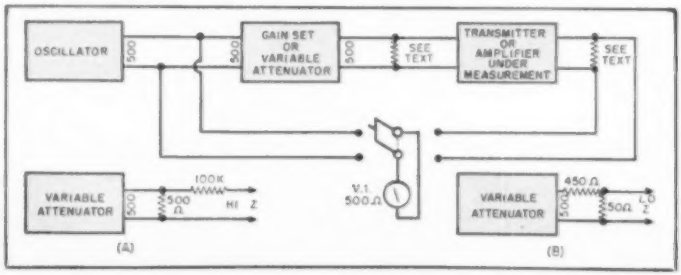
A block diagram of such a setup appears in Fig. 6. It will be noted that no provision for terminating the oscillator output is provided since the gain set itself provides the necessary termination.

If we are making a run on a transmitter or amplifier which has a 500 ohm input we merely connect the output terminals of the gain set across the input terminals of the equipment on which the run is to be made. However if, as is very frequently the case, the input impedance of the device to be measured is greater than 500 ohms we must make other arrangements. Let us say the input is to a grid. In this case we terminate our gain set with a 500 ohm non-inductive resistor and "build out" the impedance to look like the correct value to feed into the equipment to be measured. This procedure is illustrated in Fig. 6A where the 100,000 ohm non-inductive resistor is the build out to satisfy the input requirements. This value of 100,000 ohms is conventional for grid inputs. The same technique will apply to the output of the equipment in order to obtain an output impedance of 500 ohms across which our *VI* can be switched as shown in the diagram.

Let us assume now that the input circuit of an amplifier has been designed for a 50 ohm microphone. In this case we proceed as shown in Fig. 6B where we terminate the gain set with two non-inductive resistors in series, one of 450 ohms and one of 50 ohms on the lower, or grounded, side of the output. The input connection for the amplifier is taken from across the 50 ohm resistor as shown.

After making the proper connections between the test equipment and the equipment to be measured the oscillator should be set at 1000 cycles (this should always be taken as the reference frequency) and the level adjusted to make the *VI* read 0 level when connected across the oscillator output.

Fig. 6. Block diagram of the setup used for making the test measurements.



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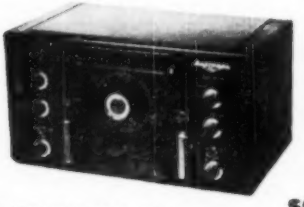

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Next introduce an amount of attenuation in the circuit, by means of the gain set, which is thought to be about equal to the expected gain through the amplifier and switch the *VI* to the output of the equipment under measurement. Correct the amount of attenuation in the circuit and the oscillator output gain control until the *VI* reads 0 level on both oscillator and amplifier outputs (the amplifier output having been to 500 ohms as explained, and shown in Fig. 6) as it is switched back and forth between the two points. The amount of attenuation remaining in the gain set when the *VI* reads 0 level in both positions is the gain in db. of the amplifier at 1000 cycles. As many other frequencies may be used as needed to get an adequate curve; the procedure is repeated for each change in frequency. Plotting the results on semi-log paper will facilitate matters since the scales will not be so crowded. Thus, the final result will be a curve showing the gain, or loss, in db. at all frequencies referred to the 1000 cycle reference point.

It might be mentioned here that any vacuum tube voltmeter such as the *Ballantine* or other similar type meter may be substituted for the *VI* meter shown. Where one has access to a laboratory or test station where a number of such meters are available one may be used on the oscillator output and another on the amplifier output thus avoiding the necessity of switching meters.

Many additional types of measurement may be made with the equipment described such as measuring transformer response, power handling capability, output determinations, etc. Terman's "Measurements In Radio Engineering" and "Radio Engineers Handbook" are among the many excellent references available. —30—

What's New in Radio

(*Continued from page 80*)

The weight of the 16RP4 is approximately two-thirds that of the 16-inch all-glass round tube. No high-voltage isolation of the tube is required. Magnetic focus and deflection are employed.

Complete technical data on the 16RP4 is available from the company in Salem, Massachusetts.

IMPEDANCE BRIDGE KIT

Heath Company of Benton Harbor, Michigan, has added an impedance

bridge kit to its line of build-it-yourself test instruments.

The kit includes a *General Radio* main calibrated control and 1000 cycle hummer, *Mallory* ceramic switches with 60 degree indexing, and a 200 microampere zero-center galvanometer. The ceramic non-inductive decade resistors have a tolerance of ½ of 1%.

When assembled, the instrument will measure inductance from 10 microhenrys to 100 henrys, capacitance

William J. Knott, president of The Knott Corporation, presses the button which puts into operation the RCA Master Television Antenna System installed at New York's Shelton Hotel. With Mr. Knott (left to right) are B. T. Davey, manager of the Shelton, Frank Folsom, president of RCA, and Frederick O. Cosgrove, vice-president and general manager of The Knott Corporation and president of the Hotel Association of New York City. The Shelton is the first hotel in the country to install free television for the use of all of its transient guests.

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Right Angle Bend 3" radius E or H plain—Choke flanges $17.50

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3 CENTIMETER

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90 degree twist, 6 inches long $8.00

723 AB Mixer—Beacon Dual Oscillator Mount with Crystal holder $12.00

2 Way Wave Guide directional coupler, type N fitting 1¼" x ½" guide 260B $18.50

TR-ATR Section, APS 15, for 1824, with 724 ATR Cavity with 1824 and 724 tubes $21.00

Crystal mount in waveguide $17.50

Stabilizer Cavity with bellows $21.50

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TRANSITION 1 x ½ to 1¼ x ⅝, 14 in. $8.00

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SLUG TUNER/ATTENUATOR, W. E. guide, gold plated $6.50

TWIST 90 deg. 5" choke to Cover w/press nipple $6.50

ROTARY JOINT choke to choke with choke coupling $17.50

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AT-48/UP 3 CM Horn with type N fitting $5.00

1.25 CENTIMETER

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2x10	150		
2x8	150		
12	525		
15	525		
10	450		
8	450		
60	150		
40+20+20	150		
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40+10+10	450		80
40 40 25	475	400	50
40 20 25	450	50	50
40 40 16	450	400	350
40	450		50
2x30 15 20	400	25	60
50 15 10 20	450	25	75
3x10 10	450	25	60
3x10 20	400	25	60
80 40 180	600	50	100
2x80 60	250		65
150 50 25	150		40
20 10 50	450	50	40
2x20 20	450	25	50
40 20 20	400	25	50
40 40 25	400	25	50
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16	450	.40
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20	25	.30
20	80	.25
20	450	.40
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8	450	.35
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10	80	.10
4	80	.10
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20 20	150	.44
22 20	350	.60
30 30	150	.40
32 32	350	.60
30 50	150	.42
40 20	150	.42
40 32	250	.60
40 40	150	.42
40 40	350	.65
3x40 10	150	.70
80 40 30 100	150	25 1.20
8 8 25	450	75 1.20
30 20 30	450	25 1.10
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23Z6	559	1961
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23Z9	813	9004
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3BP1	2N3-A	R-127
3DP1	2N5-A	RK 25A
3C 30	2N6-A	GL 562
3E36	200 A,Y	RC 271
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3LP1	5719-Y	QK 62
3RP1	713-B	QK 66
3SP1	720B/Y	QK 81
3WP1	724B/Y	QK 82
5CP7	724C-A	RK 91
5130	725-A/B	VR 130
6G6	724B	VR 135
6SK7	725A	VR 150
7C4	726-A	VT 120
7E5	726 A/Y	VT 134
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550VCT	100	6.3V 1.6, 6.3V/8	2.29
580VCT	.040	5VCT/3	2.95
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2300V	.001	2.5V/2A	6.40
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2500VCT	.077	4.95	12TV	1.5	3.38
690V	.400	12.95	120.5V	1.5	
1400VCT	1.2	24.80	115V	1.5	

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2.5V 7, 6.4V 10, 6.4V 2.5	1.95	5VCT, 12.5A, 2x5VCT 4.75	6.95
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6.3VCT, 1.2, 6.3VCT 1A	2.25	2.5V/7A	
5V 5A	1.95	6V 5A	1.50

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230V 60 Cy	2.5VCT 4A	1.49
220V 60 Cy	2.5V 9.5A	1.95
220V 60 Cy	700V/20A, 660 MA, 3V 3A	2.95
220, 440V 60 Cy	230VCT/200 MA	2.95
220V 60 Cy	550V/60A, 300V 1A, 6.3V 4.2	2.95
220V 60 Cy	700VCT, 15 MA, 40VCT, 1A, 15.5V 1.2 Amp	2.39
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2 HY 600 MA	1.95	11 HY 66 MA	1.39
Swing 1.0, 3.3 HY .225/.12 Amp.	1.75	6Y 225 MA	2.25
27 HY 600 MA, 66 HY 60 MA			3.75
Dual 1.5Z HY 165A	$1.95	100 HY 148	$3.00
Dual 125 HY 17 MA	2.49	333 HY 1.125	2.29
Dual 10 HY 150 MA	3.50	3 HY 1 Amp	3.95
2.5 HY 300 MA	4.95	10 HY 1 Amp	7.95
10 HY 500 MA	12.95	30 HY 450 MA	12.45
Swing 9-20 HY .525/.075			14.95
5 HY 150 MA	1.50	25 HY 150 MA	$1.25
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The Television Field; Ultra-high Frequency Waves and The Television Antenna; Wide-band Tuning Circuits; Radio-frequency Amplifiers, The High-frequency Oscillator, Mixer and Intermediate-frequency Amplifiers; Diode Detectors and Automatic Gain-control Circuits; Video Amplifiers; Direct Current Reinsertion; Cathode-ray Tubes; Synchronizing-circuit Fundamentals; Deflecting Systems; Typical Television Receiver—Analysis and Alignment; Frequency Modulation; Intercarrier Television Sound System; Servicing Television Receivers; Color Television; Glossary of Television Terms. Plus Other New Chapters and Expanded Sections.

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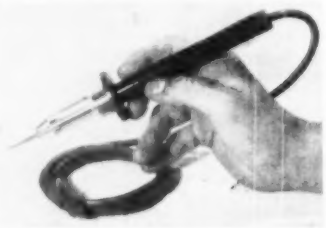
from .00001 μfd. to 1000 μfd., and resistance from .01 ohm to 10 megohms. Dissipation factor from .001 to 1 and "Q" from 1 to 1000 can be measured. The bridge uses an internal 6 volt battery for resistance and hummer operation. The circuit uses Wheatstone, Hay, and Maxwell circuits for various measurements.

TV MULTIPLIER PROBE

A new multiplier probe that extends the usefulness of existing d.c. voltmeters into the television range has



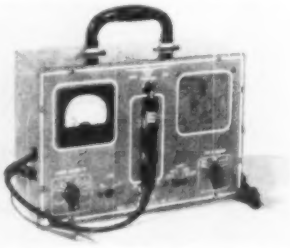
been introduced by *Insuline Corporation of America*, Long Island City 1, New York.

Designated the "Kilovolter," the device is built with a phenolic barrel and a clear lucite nose piece, providing positive protection against the highest television voltages. The probe is 8½ inches long and is fitted with a 5-foot heavy-duty test lead.

The new probe, in effect, adds 15,000 volts to the scale reading of conventional high-resistance voltmeters used in radio servicing and general experimental work. Three models are available, for 50, 100, and 200 microampere meter movements.

NEW SIGNAL TRACER

The Model 777A Dynatracer, a new model signal tracer marketed by *Radio City Products Co.*, of 152 W. 25th Street, New York 1, N. Y., features exceptionally high amplification which permits actual gain measurements to be made on receivers or other apparatus. An accurate meter gives cal-



ibrated indications which are impossible with magic eye indicators.

The input capacity of the unit is 3 μfd. Attenuation is 10,000 to 1 by means of a ladder attenuator with vernier control. Sensitivity is 10,000 microvolts for full scale deflection of meter or 200 microvolts per division. The frequency range covers approximately 160 mc.

A jack is provided for testing microphones and pickups. An automatic control switch permits either a speaker or the meter to be used alone, together or as standby.

CONVERSION KITS

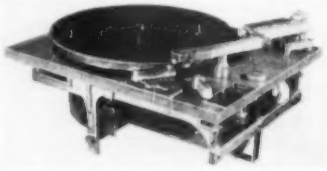
Teleramic Conversion Kits, which convert 10" size television sets to 15" glass or 16" metal direct view sets, are now being manufactured by *Eagle Electronics, Inc.*, 88 Walker St., New York 13.

Any set using the *RCA* 630 TS circuit, or other standard TV with flyback circuit, the *Transvision* chassis, or other similar kit chassis may be converted in one hour by following the simple illustrated instructions. No magnifiers or lenses are used and there are no holes to drill.

The new kit contains all the necessary components including front and rear mounting brackets plus an insulation ring and sleeve, horizontal output transformer, and tube. The subassembly chassis is completely wired and ready for installation.

PLAYBACK UNIT

Proctor Soundex Corporation of Mount Vernon, New York, is introducing its new "Floating Disc Drive" playback unit to the trade.



The multi-speed turntable employs a new drive system which consists of a flexible aluminum drive disc, shock mounted at the center to the turntable shaft. The drive disc and turntable shaft are isolated from direct contact and the drive disc is held free by the shock mounting so that it is self-aligning with two drive rollers that it passes between. The speed is continuously variable between 30 and 110 r.p.m. Pickup pressures can be varied between 0 and 25 grams. Various types of cartridges can be used.

4-ELEMENT YAGI

Trio Manufacturing Company of Griggsville, Illinois, is currently marketing a 4-element Yagi antenna with a double dipole for extreme fringe area reception.

This antenna provides high forward gain with unusual directional characteristics. It is available for each of the 12 channels although considerable gain may be expected on adjacent channels, according to the company. The gain on the optimum channel is 10 db. with a front-to-back ratio of 25 db.

This Yagi weighs only 5 pounds for channel 5. Satisfactory installations may be made using a 30 foot mast of 1¼ inch aluminum. An adjustable

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BC-605 INTERPHONE AMPLIFIER

Easily converted to an ideal inter communications set for office—home—or factory.
Original—New $4.95
Like New 3.95
(With schematic)

Conversion Diagram and Instructions complete with necessary parts

This kit consists of 3 tubes—2 speakers—1 speaker baffle (for remote speaker)—100 ft. 2-cord cable—1 switch—1 line cord—2 etched plates—miscellaneous resistors—condensers—hardware—and all that is necessary to convert. New **$8.25**

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ARB Receiver 200 to 9000 K...	Exc. Used	$19.95
SCR 522 Transceiver 100 to 156 MC	Used	34.95
BC 1206 Receiver 200 to 400 KC...	New	9.95
	Used	1.95
MN 26 C or Y Receiver	New	24.95
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BD 71 Switchboard	New	12.95
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PE-237 Power Supply	New	9.95
BC-347 Interphone Amplifier with tubes	New	.95
I-70 Meter	New	.89
	10 for	8.00
RT 7—APN-1 Transceiver	New	9.95
APN-1 complete	New	24.50
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BC 442 Less Condenser	Used	1.49
BC 342-J—BC-312-J—Manual		1.00
SCR 269 (3 Manual		2.50
BC 306 Antenna T.U. for BC 375		1.50
A-27 Phantom Antenna—2000 to 4500 KC	New	.95
APS-13 UHF Antenna—Suitable for 400 MC ranges and, ideal for UHF experimenters. With director and reflector elements—Brand New. 2 for 98c		

AN/APN-4

Indicator. Uses 5 CP1, Loran, convert to test scope, panadapter, etc. Contains extremely accurate 100 kc xtal to time sweeps and marker pips at 2, 20 and 100 kc. Two parallel horizontal sweeps, obtain time differences between signals, between half power points on pen and curves, and numerous other scope uses. Experimenters' delight! Use the counter circuits to try the new system of FM demodulation (July Proc. IRE) or to time camera shutters, 25 tubes. Condition: used, excellent. With schematic **$29.50**

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Easily Converted for Use in Citizens Band

Crystal Controlled Local Oscillator. Freqd Band Freq—20-7 MC I.F.'s. Complete with 7-6AJ5, 1—12SR7, 2—12SN7, 1—28D7, relays, crystals. Schematic furnished ..... Used **$7.95**

SURPRISE PACKAGE 20 lbs. Ass't radio parts. A $25.00 value for only **$1.95**

BC-620 F.M.—Receiver, Transmitter—2 channel crystal—Freq. 20-27.8 MC, 13 tubes—metered plate and bl ..... New **$14.95**
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FT-250 Mount for PE-97 and BC-620 ..... **$1.50**

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Hi-Fi used in Scott Manufactured Navy receiver. Fully potted. Pri. 5000 ohms, output secondary 600 ohms C.T.—Inverse feedback secondary CT-60 ohms. New **$1.45**

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24V DC will operate on AC—11,000 RPM. Complete with gear box and limit switches ..... ea. **$2.95**

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BC-442	.99	2.95
3 Receiver Rack	1.95	
2 Transmitter Rack	1.50	

Complete Command set as removed from aircraft—3 receivers—2 transmitters—Relay unit—control boxes—mounting racks—plugs—modulator and dynamotors—crated. Set **$34.50**

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HS-23 Hi Imp.	New	$2.95
HS-33 Lo Imp.	New	2.95
HS-30 Hi Imp.	New	1.50
	Used	.79
T-17D Carbon Mike	New	2.75
T-24 Hi Imp. Carbon Mike	New	1.19
T-30 Throat Mike	New	.98
T-45 (or Navy) Lip Mike	New	.98
CD-307 Extension Cord for Headsets	New	.59
RS-38—Navy hand Mike Carbon		2.75

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Transmitter selsyn for above		2.45
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Transmitter Selsyn for above		2.45
	both for	5.25
I 81	Used	2.45

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10 H. 20 M.A.	39c

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110 VAC—600 to 2400 CPS input. Used to supply many voltages for APS 3 equipment. Contains four VR105, Three 5U4G, 2a2, 6AC7, 6T6-G, VR 150/6X5GT-G condensers, chokes, etc. Parts alone worth more than **$6.95**

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11 and 15 meters. Can be operated on 10 meters—10 channel push button crystal. With all tubes and meter but less dynamotor. Excellent Condition **$12.95**
Crystals—Set of 80 ..... **14.95**

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Nationally Advertised Brands—All Brand New

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1A6	.49	6L6G	.49	39 44	.24
1B3, 26B	.49	6L7G	.49	47	.39
1B22	1.95	6R7	.49	48	.39
1B26	2.95	6SF5GT	.39	50	.69
1B29	.89	6SB7Y	.69	56	.29
1B32-532A	2.95	6SF7	.49	57	.29
1C6	.49	6SJ7	.69	76	.29
1C7G	.49	6T7G	.69	77	.39
1D5GP	.49	6U7G	.39	211, VT4L	.39
1D7G	.49	6Z7G	.69	250P	
1F6	.49	6ZY6G	.39	VT158	1.29
1F8G	.49	1C4 1203A	.29	3166	.39
1H4G	.39	7E5 1201	.69	3718	.39
1J6G	.49	10Y VT26A	.19	703A	1.95
1J6GT	.49	12A6	.39	705A	.98
1N5GT	.49	12A6GT	.39	714AY	8.95
1P5GT	.49	12A7	.39	724B	4.95
1V	.49	12A8GT	.39	801A	.69
2A3	.39	12C8Y	.39	836	.95
2A6	.39	12F5GT	.29	837	1.95
2A7	.39	12H6	.39	841	.39
2C26A	.19	12J5GT	.29	864	.69
2V3G	.49	12J7GT	.39	872A	1.29
2X2 879	.39	12K8GT	.39	954	.19
3B7 1291	.39	12Q7GT	.39	955	.39
3D6 1299	.39	12SF5	.29	957	.39
3EP7	.98	12SF5GT	.39	1625	.19
4AP10	.98	12SF7	.29	1626	.29
5BP1	1.95	12SH7	.29	1629	.29
5BP4	2.95	12SR7	.29	1630	.69
5CP1	2.95	12SR7GT	.29	1636	2.95
5D21	19.95	12Z3	.29	1638	.69
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6B8	.59	30	.29	GL6A3Y	.29
6C4	.29	32L7GT	.89	Amperite 10T1	.29
6D8G	.69	33	.29	Jan CRP72	1.49
6F5GT	.39	34	.29	WE 331A	.69
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6J6	.89	36	.29	VR150	.39
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	Used .95	(3 for $2.00)
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High definition—Giant Screen 16" Direct View. Built-in self-contained antenna . . . Height 40⅛", Width 21⅝", Depth 23⅜". Beautifully styled fine cabinet work in mahogany or walnut. An outstanding value. List $369.95

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HIGH FIDELITY CRYSTAL MICROPHONE Sensitive diaphragm type, bi-lateral, 1¾"x 5⅛" deep. Holder clock-mtd. Less housing **98c**

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12"x4"x10½" Dbl. Ext. all steel

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150 WATT XMITTERS

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BC 375-E (COMPLETE)

INCLUDES:
7 Tuning Units (Plug-in drawers, with handles, to cover freq. range 200 kc—12.5 mc., except 500—1,500 kc.)

Made by G.E. for aircraft, ground & mobile use. Has 24-volt (filtered) DC Dynamotor; antenna tuning unit; connectors, mounts. Net wgt. 225 lbs. Excellent condition.

YOUR PRICE..... **$79.50 ea.**

(Write for literature, quan. discts.)

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Uncle Sam's Aerial Weather Station

This AN/AMQ-11B battery powered radiosonde operates on 72 mc. Comes **with 3A5 tubes**; ant. and counterpoise wires; hygrometer, barometer and thermometer elements; sensitive relay. Wired ready to use! Original packing: 14¾x8¾x8 inches high; Net wgt., 11¼ lbs.

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COMPONENTS SUPPLY CO.
161A Washington St.
New York 6, N. Y. BEekman 3-8717, 8

mast clamp allows installation of more than one antenna on a single mast with independent orientation of each.

The units are supplied complete with a 6 foot section of 1¼ inch mast, adjustable roof bracket, guy wire ring, etc.

MAST BASE

McKinney Steel & Sales Co. of 8 Madison Street, Waukegan, Illinois, has introduced an ingenious mast base for use in antenna installations in fringe areas or in locations where proper support and ease of erection are additional factors in the cost of installation.

Known as the "Swiv-L-Lock" mast base, this unit will accommodate masts up to 1¾" in diameter without adaptors. It permits complete rotation and locking of the antenna mast. The base is constructed of rustproof steel and measures 8" by 8" by 5" high. The base can be installed on any pitch surface, flat, slant, or perpendicular. It will handle up to a 65 foot antenna. The unit is completely assembled at the factory.

MOBILE ANTENNA

Master Mobile Mounts, Inc., 5200 Wilshire Blvd., Los Angeles, California, has introduced the Master M-75 mobile antenna for amateur applications.

An all-band, plug-in coil antenna, the M-75 especially designed center load is engineered for maximum efficiency and flexibility. It is possible to change coils to any band, 80 through 10. The unit is supplied with a coil for 75 meters and comes tuned to approximately 3600 kc. It may be adjusted to the desired operating frequency and

may be used for 10 meter operation by simply shorting the coil. 20 and 40 meter coils are available.

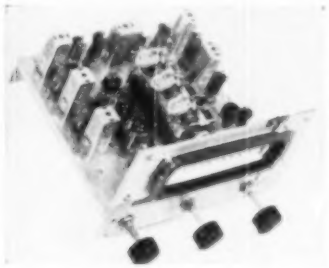
The unit weighs 28 ounces and has an over-all length of 8 feet, 10 inches. It is entirely chromium plated. The antenna is designed to fit into any of the company's "Master Mounts" or ⅜ SAE threading.

FM-AM TUNER

Approved Electronic Instrument Corp., 142 Liberty Street, New York 6, New York, is marketing its new Model A-710 high fidelity FM-AM tuner for

the custom builder, service technician, manufacturer, and experimenter.

This 12-tube tuner measures only 8¼ inches wide, 5⅜ inches high, and 8 inches in depth. It features a six-section variable condenser, temperature-compensated trimmers on FM, separate tuning and i.f. channels for FM and AM. The set has a horizontal



tuning scale and escutcheon plate and knobs. Complete operating instructions and a circuit diagram accompany the unit. Net weight is 5½ pounds. Standard miniature tubes are used throughout.

—30—

International Short-Wave

(*Continued from page* 61)

English, Spanish, and Portuguese—and maybe in other languages, too."

Brazil—Radio Nacional, PRL-8, 11.72, has discontinued its "Hello, America" broadcasts in *English;* confirmed in letter from station authorities but no reason given. (Worris, N. Y.; PSL, 7.935, Rio de Janeiro, noted 1730-1800. (Sutton, Ohio) *Radio Jornal do Commercio*, ZYK-2, 15.145, 6.085, and ZYK-3, 9.565, 11.825, is sending out attractive literature in *English;* lists *English* programs as "About Brazil," 2030 Monday through Saturday, and "Brazil Calling" 1530 Sunday. Slogan in *English* appears "Pernambuco Speaking to the World."

British Honduras—ZIK-2, 10.599, Belize, recently has been audible to fairly good weekdays around 1300-1330 or slightly later; has "folksy" program of news, announcements, music. On Sundays this one extends to *after* 1415, according to Stark, Texas.

British New Guinea—Balbi, Calif., converts current Pt. Moresby schedules to VLT7, 9.52, Sunday to Friday 2100-2300, 0030-0300. Saturday 2100-0300, Sunday 0100-0300. VLT5, 7.28, Sunday, Tuesday, Thursday 1645-1900, Friday to 1730, Saturday to 2000, Monday 0315-0930, Saturday to 0800, Sunday to 0700.

Canada—According to CBC's current program listings, a DX program called "International Short-Wave Listening" is now radiated 1745 Tuesdays over CKLO, 9.63; CHOL, 11.72. (Hilton, Fla., Lyttle, Ontario) Latest schedules are given for CKRP, 21.60; CKNC, 17.82; CKCS, 15.32; CKCX, 15.19;

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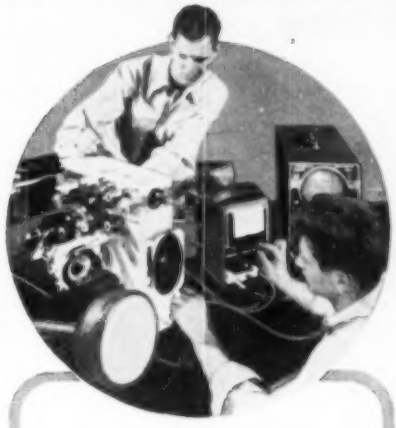

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CKLA, 15.09; CKRA, 11.76; CHOL, 11.72; CKLO, 9.63; CKRZ, 6.06. To Europe 0945-1130, CKCX, CKNC; 1130-1500, CKCS, CKNC; 1500-1530, CKCS, CHOL; 1530-1815, CKLO, CHOL; 1815-1850, CKLO, CKRZ. To South Africa (except Sunday, Monday) with commentaries from the UN, 0850-0920, CKRP, CKNC. To Australia, New Zealand (Except Saturday, Sunday) with commentaries from the UN, 2320-0000, CKLX, CHOL; on Sunday only with *English* for listeners in Southwest Pacific area, 0340-0530, CHOL, CKLO. To Latin America and the Caribbean, 1910-2235, CKCX, CKRA.

CFRX, 6.070, Toronto, Ontario, scheduled 0530-2330. (Drummond, N. J.) St. John's, Newfoundland, 5.970, heard signing off 2234, said would return 0730; fair signal in Kentucky. (Alcock)

Canary Islands—Tenerife, 7.517.2 (measured), noted with good signal 1715. (Oskay, N. J.) Pearce, England, lists winter schedule of 1700-1800; sent QSL card.

Ceylon—Radio Ceylon verified with nice letter; listed schedule as 15.120, 0915-1205 to India, Pakistan; 17.730, 0325-0900 for Hongkong, China, Japan, and 21.620, 0325-1205 for Fr. Indo-China, Burma, Malaya. (Oskay, N. J.) Colombo, 4.900, logged in England around 1145; closes 1200 with "God Save the King." (Patrick)

China—Peiping, 10.26, recently has been heard in the Eastern U.S. opening 1800 with a long march-anthem; sometimes is better level than mornings (EST). I also have heard this one lately around 0030. Bellington, N.Y., reports it around 0215 to sign-off with march, closedown varying 0312-0350.

Old XGOE, 9.86, heard 0530 with Chinese news; is listed 9.82 as at Kweilin. BEL2, 11.50, noted 0630 with Chinese news; identifies as BEL2 and BEL7; BEL-, Hankow, listed 11.492. ZBW-3, 9.525, Hongkong, noted 0430, good signal in news, music. (Sanderson, Australia)

Dilg and Balbi, Calif., confirm that Chungking, 11.913, now runs to around 1245 final sign-off.

"The Voice of Free China" at Taiwan, Formosa, operates around 0500-1130 (irregularly) on 11.725; some *English*. Widely reported. A similar outlet is heard with programs for the U.S. daily 2300-0100 on 15.235; first hour is *English* but at times is difficult to copy due to QRM underneath from Tokyo; best in West Virginia during last hour (in Chinese). Definitely announces "This is the Voice of Free China, broadcasting from Taiwan," and gives call BED3.

Revised winter schedule for Chungking is daily BEF7, 11.913, 0800-1250 (news 0900, 1100); lists religious programs for BEF8, 15.17, Sunday 0525-0635; Monday 0640-0705; Saturday 0555-0635. (Fried, Mich., Lyttle, Ontario)

Colombia—Current frequencies and schedules of *Radiodifusora Nacional de Colombia* are HJCQ, 11.680, HJCT, 6.200, HJCQ, 4.955, and HJCR, 1200 kc., weekdays 1000-1400, 1700-2315; Sundays 1030-1515, 1815-2315; this is from latest monthly bulletin. (McPheeters, N.Y.)

Costa Rica—Widely reported is *new* "Lighthouse of the Caribbean," TIFC, 9.645, 1600-0005; QRA is P.O. Box 1307, San Jose; 350 watts.

Czechoslovakia—OLR2A, 6.010, Prague, signs on 1415; news 1445, 1645. The 11.76 outlet heard daily signing on 0100 with Spanish news bulletin, evidently for Spain. (Pearce, England) When this was compiled was still using 11.84 at 1900-2000 to North America, bad QRM.

France—Paris has inaugurated a French transmission for Canada 1830-1845 and in Spanish for Latin America 1800-1815 on (announced) 9.55, 11.70. These channels are still used for the

Transmitter buildings of the "Voice of America's" relay station at Manila.

English transmission to North America 1945-2000. (Worris, N.Y.) Paris by this time or shortly should expand its North America transmissions.

French Indo-China—By this time, Saigon was to have changed identification from "Voice of France in the Far East" to "France-sie, Saigon" (may mean "Francaise, Saigon"—KRB). This was to be announced at the beginning and end of all sessions. This station has been in the process of reorganization and has been installing some new equipment; expected to make changes in schedule. (Good, England)

The 11.78 outlet has been heard opening 1800 with "La Marseillaise;" uses a little sequence of notes as a "coming-on" interval. (Stark, Texas) I hear this one with bad QRM. Sanderson reports it 0500 with news. *English* sessions scheduled 1830-1845, 1930-2000, 0430-0530, 0830-0930.

French Morocco—Bluman, Israel, lists CNR-3, 6.006, Rabat, 2.5 kw., at 0145-0330, 1300-1830.

French West Africa—FHE2, *Radio Dakar*, heard 1500-1530 sign-off on approximately 15.340. (GDX-aren, Sweden) Listed 15.345.

On 11.898 now has *English* news by woman daily 1400. (Pearce, England) May be as low as 11.890 now.

Gold Coast—Cushen, N.Z., received verification from ZOY, Accra, listed 9.640 Monday through Saturday 0530-0700, 4.915 Monday through Saturday 1030-1300. (Radio Australia)

Greece—Radio Athens, 15.345, noted opening 1015 with Greek at dictation speed. (Fargo, Ga.) Bluman, Israel, says the Greek Communist Radio has not been heard lately; the number of low-powered s.w. stations—presumably run for the benefit of the Greek Army—is still increasing; at present, Greek stations can be heard on 6.350 at 1100-1645, unidentified; 6.530, Chios, 1200-1500; 6.745, Larissa, 2330-0130, 1200-1600; 7.020 from 0000, unidentified; 7.050, Nauplia, 2330-0200, 1100-1630; 7.105, Makronesio, 0000-0130, 1200-1500; says 6.350 appears to be a relay of m.w. outlet.

Greenland—A station heard on 5.942 around 1653-1745 is believed to be Godthaab. (Bellington, N.Y., Sutton, Ohio, Oskay, N.J.) Heard in Sweden 1700-1745. (NATTUGGLAN)

Guatemala—TGWA, 9.76, Guatemala City, off the air since the Revolution in that country, should be back on regular schedule by this time, according to word direct from the station. (Boice, Conn.) Formerly used 15.17 daytime, 9.76 nights.

Haiti—Full schedule of 4VRW, 10.135, Port-au-Prince, is daily 0600-0800, 1200-1500, 1800-2200; Sunday 1200-1700. (Sutton, Ohio) The Haiti station on 6.407 at 1830-2030 is 4VCN, Port-au-Prince; all-French; fair level with some CWQRM. (Black, Pa.)

Holland—PCJ, Hilversum, is sending out a free picture of a Constellation airship in celebration of the 30th anniversary of KLM Airlines; also a

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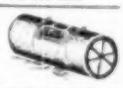

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Used, with Radio Control Unit BC-434-A. Contains 2 ARN-5 Receivers, MN-26 Compass, MN-20 Rotatable Loop, Control Box, Only $4.95

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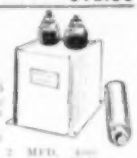

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21 HENRY, DETROIT 1, MICH.

map showing principal s.w. stations of the world. (Bellington, N.Y.) The 21.480 outlet transmits to Surinam and West Indies 0945. (McPheeters, N.Y.) *New* schedule for the "*Happy Station Programs*" presented by Eddie Startz is Sunday and Wednesday 0930-1100 on 6.025, 15.220, 17.770, repeated 1600 and 2200 on 6.025, 9.590, 11.730; for Pacific on Tuesday 0600-0730 on 6.025, 15.220, 17.770, 21.480. (Radio Sweden)

Hungary—Budapest seems to have increased power; heard on about 9.830 with good level in New York 1630 with news by man. (Bellington) Is good level in West Virginia; asks for reports. Pearce, England, says appears to be testing with increased power on both 6.247, approximately 9.830.

India—AIR announces its 1400-1500 daily broadcast for Overseas Listeners as on 11.71, 11.76, 9.62, and 7.24 now; heard on all these in England. (Pearce) Madras, 4.920, is audible to fair now in West Virginia 0730 with news; heard in England by Brownless at 1215, good level.

Indonesia—At the time this was being compiled I received word from Balbi, Calif., that he had heard a *Radio Batavia* outlet on 6.05 which may be the *new* 100 kw. transmitter. Noted 0500-0630 with "local" signal; had *English* news 0600. Dilg, Calif., noted this one the same day as Balbi at 0900 in Dutch; signs off 1000 with Dutch National Anthem; listed frequencies of 15.15, 11.77, 7.27, but did not mention the new one. Dilg gave frequency as approximately 6.045; says has QRM from BFEBS, 6.045, Singapore. Fuller, Rhode Island, has again been hearing Batavia's 19.345 channel around 1200.

Radio Sumatra, Medan, signs off 1100 on 7.355 with "Marching Through Georgia" and Dutch National Anthem; *English* request program heard from 0939 (may not be daily). Pontianak, 8.090, closes 0930 with Dutch National Anthem. "This is Radio Republic Indonesia broadcasting from Djokjakarta" is the identification during *English* session 0900-0930 from the Indonesian outlet on 5.060. (Gillett, Australia)

Iran—Teheran, 15.100, lately has had two short periods of news—1400 and 1500. (Pearce, England)

Iraq—GDX-aren, Sweden, says Baghdad, 7.062, "The Voice of Iraq," transmits in *English* 1230. Also reported by other Swedish sources.

Israel—The *new* 7.5 kw. transmitter at Tel Aviv is now on regular schedule on 9.000 at 1200-1300 with special programs for new immigrants and displaced persons, using Yiddish, French, Spanish; at 1300-1315 relays "Kol-Israel." *The 50 kw. transmitter is expected to start tests in the spring.* (Bluman, Israel) Heard well on 9.000 at 1430 news period by Gillett, South Australia, who hears Tel Aviv, 6.830, and Haifa, 8.170, in parallel but much weaker; Haifa has been heard as late as 1645.

Italy—Rome, 9.63, 11.81 (best), has news 1430. (Fargo, Ga.) Some weeks ago *Radio Sweden* reported experimental transmissions had been heard from a station at Parma on approximately 7.590 at 1500-1530 sign-off.

Jamaica—ZQI, 3.48, Kingston, good lately evenings around 1930-2200. (Cox, Dela.) The 4.950 outlet has been fairly good around 1700-1730 recently. (Sink, N.Y.) Latter heard well here in West Virginia.

Japan—JBD-4, 15.235, noted with weak signal 1850; measured 15.235.4; some QRM from Moscow on (measured) 15.231, and from KNBX; however, QRM eases when KNBX signs off 1900. JBD-3, 15.225, quite good around 1830, measured 15.225.5. (Oskay, N.J.)

Kashmir—Nordh, Sweden, flashes

(*Continued on page* 138)

DOCKET 9295 REVISIONS

FOLLOWING the recent FCC hearing on the controversial Docket 9295 covering the proposed new amateur regulations, a revised Docket 9295 was issued. Oral arguments on this revised docket may be held depending on the comments received. Essentially, these revised rules are as reported in the December issue of RADIO & TELEVISION NEWS on page 54. A brief resume of the new proposals is as follows:

BAND ALLOCATIONS

AM phone: 3800-4000 kc., 14,200-14,300 kc., 28.5-29.7 mc. NBFM phone: 3800-3850 kc., 14,200-14,250 kc., 28.5-29.7 mc. with these frequencies limited to Advanced Class (Class A) operators.

A1, A2, A3, A4, and NBFM: 50-54 mc.

NBFM is defined as having a bandwidth no greater than that occupied by an AM signal containing the same frequencies.

LICENSE CLASSES

Extra Class: No special privileges at this time but additional privileges may be granted in the future. Exam consists of elements 1(E), 2, 3, and 4(E).

Advanced Class (Class A): No new Advanced Class or Class A licenses will be issued after December 31, 1951. Exam consists of elements 1, 2, 3, and 4.

General Class (Class B) and Conditional Class (Class C): Exam covers elements 1, 2, and 3.

Technician Class: Exam covers elements 1(NT), 2, and 3.

Novice Class: Exam covers elements 1(NT), and 3(N).

EXAMINATION ELEMENTS

1. 13 w.p.m.; 1(E), 20 w.p.m.; 1(NT), 5 w.p.m. code speed.

2. Amateur radio operation and apparatus, including telephone and telegraph.

3. Provisions of treaties, statutes, and regulations affecting amateurs. 3(N) Rules and regulations essential to beginner's operation, including elementary theory.

4. Advanced amateur radiotelephony. 4(E). Advanced radio theory and operation as utilized in modern amateur techniques, including, but not limited to radiotelephony, radiotelegraphy, transmissions of energy for measurements and observations applied to propagation, to the radio control of remote objects and for similar experimental purposes. —30—

address amplifiers is very similar to that employed in the *Bell* 510, except that a 6Y7G is used instead of the 6N7 as a phase inverter and driver for the 6V6's. The same modifications for the *Bell* amplifier will also apply to this and similar amplifiers. In the 12B60 series, low-frequency response may be improved a great deal by installing a 10 μfd., 50 volt electrolytic condenser across the cathode of the 6V6 output stage in case of unbalance.

Miscellaneous Improvements

Old-type amplifiers not equipped with a tone control or equalizer can be improved by adding a simple series circuit comprising a 500,000 ohm potentiometer and a .006 to .01 μfd., 600 volt condenser. This control circuit can be connected across the grids, or from plate-to-plate in push-pull stages, or from grid-to-ground (or plate-to-screen) in single-ended stages. Although this circuit admittedly is not the most desirable, it *will* aid considerably in reducing record scratch, background and surface noise, etc. with not too much sacrifice of the higher frequencies. Since most small amplifier systems are used in conjunction with a record-player or changer, this feature will be worth including. In high-fidelity amplifiers, of course, and in the higher-powered systems where a 10 to 20 db. drop in gain can be spared, a commercially-built equalizer can be added. Some high-fidelity amplifiers employ feedback and special filter circuits to attain precision performance.

In most cases, especially in older-model amplifiers, the percentage of a.c. and extraneous hum pickup can be reduced by shielding the grid leads in low-level stages and redressing, as far as possible, from a.c. leads and filament circuits. In some models improved quality and a much better signal-to-noise ratio can be obtained by installing a 50 to 100 ohm wire-wound potentiometer across the filament or heater winding in a humbucking arrangement. The arm of the potentiometer is connected to the chassis or common ground return of the amplifier and the original filament ground return (if any is used) disconnected. The control is then adjusted for minimum hum in the speaker. This adjustment can best be made with the amplifier gain controls at maximum but with the input circuit shorted. An output meter connected across the plates of the output stage can be used as an indicator.

Connecting an .01 to .1 μfd. condenser across one or both of the primary terminals of the power transformer, or from these terminals to ground, often will result in improved quality, reduction in hum, and increased circuit stability or freedom from oscillation.

Quite often the major factor which

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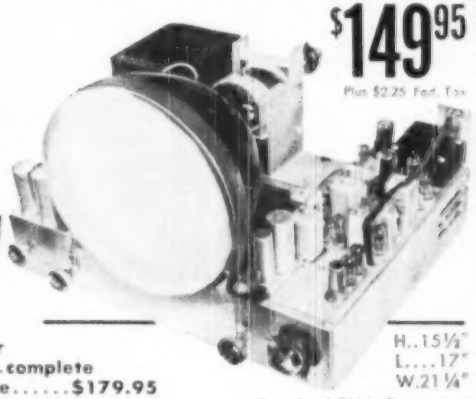

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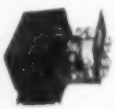

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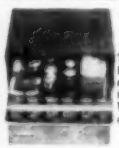

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governs the output quality of an amplifier is the limited frequency range of the speaker, especially in small, low-cost systems. Many of these systems employ 6- and 8-inch permanent magnet or dynamic speakers of medium quality and performance. As a rule, a worthwhile improvement in frequency response, along with an increase in output and operating efficiency, will be noted when these speakers are replaced with 10- or 12-inch units employing *Alnico* 5 permanent magnets. An improvement in low-frequency response and over-all efficiency in delivery will also result if the speaker is enclosed in an acoustically-treated baffle, or equipped with an exponential horn-type enclosure.

Some of the older amplifiers equipped with dynamic speakers can also be given new life by replacing these units with new PM types. The field coil should be replaced with a filter choke (or in some cases a resistor) of approximately the same resistance as the coil. An exact value is not critical unless the field coil was used in the "B—" circuit to furnish grid bias.

In this case the replacement choke should be the proper ohmic value to produce the correct bias voltage. It is best not to depend entirely on the resistance value of the old field coil—this may have changed or may not have been the optimum value in the first place. Measure the actual bias and supply voltages and change the resistance if necessary to produce the voltages recommended in the tube manual or in the manufacturer's notes, if available. Amplifier efficiency can often be stepped up by increasing plate and screen voltages, provided the maximum recommended ratings are not exceeded.

Extension speakers can often be used to solve the problem of coverage without necessitating the purchase or installation of a more powerful system. Speakers may be connected in parallel, series, or series-parallel as required to properly match the output impedance of the amplifier. Any speaker installed at a considerable distance should be fed through a 500 ohm line, with a suitable matching transformer at the amplifier and speaker end.

Many more modifications and improvements will be apparent to the p.a. service technician in individual cases. Most of these can be made without considerable cost to the customer, and in the majority of cases will give added life and utility not only to the small p.a. systems, but to large installations as well. —30—

PICTURE DISTORTION IN TV TUBES WITH METAL SIDES

By MATTHEW MANDL

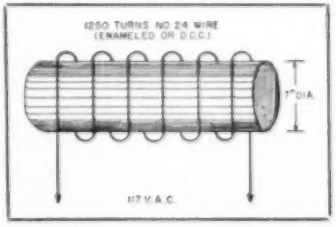
METAL-SIDED picture tubes such as the 16AP4 will sometimes give a distorted raster and picture which cannot be corrected by linearity controls. When such a condition occurs the likely cause may be that the metal cone side of the picture tube has become magnetized. A magnetized cone means that the magnetic fields thus produced will influence the electron beam within the tube in fashion similar to a permanent magnet. A small pocket compass will give an indication of the presence of magnetization, and the portions of the cone so affected can be determined by moving the compass about the entire metal surface area. If the picture tube is one of those incorporating a permanent magnet type ion trap, this will have to be removed before this check is made, otherwise the compass will give a false indication. When the places of magnetization have been determined, they can be nullified by the use of an a.c. field.

Westinghouse, in their later service notes, recommend the use of a coil which can be connected directly to the 110 volt lines. This coil consists of 1250 turns of No. 24 insulated copper wire wound around a form seven inches in diameter. Such a coil will generate magnetic lines of force of sufficient intensity to cancel out the unwanted magnetism of the cone structure. The coil is connected to the a.c. lines, and the coil end is passed over the surface of the magnetized cone. Move the coil away from the cone before removing the a.c. plug. Since this coil will overheat in a relatively short time, it should only be used at intervals. If it is to be used on several tubes, wait a few minutes between usage.

When the tube has been demagnetized, the pocket compass no longer will give an indication of the presence of magnetism, though this test should be made with the set shut off to eliminate the stray magnetic fields of yoke, focus coil, and ion trap. A further check can be made with the tube in actual use, and the picture as well as the plain raster should no longer be distorted, pulled out of shape, or have a kink at the edge of the raster.

As a precaution when servicing sets with metal cone tubes, care should be exercised to keep this metal side away from the frames of PM speakers, permanent magnet beam benders, or other magnetic fields. If the small end of the metal cone becomes magnetized, it will have the greatest effect on the electron beam within the tube because the magnetic field will be closer to the beam. Portions near the middle of the cone are also influential in disturbing the raster, though not to as great an extent as the small end of the metal cone. —30—

Construction details covering the coil used for demagnetizing metal tubes.



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3A4	6SD7GT	71A	482B	1D5GT	1G6GT
6S6GT	10	112A	483	1D7	1H4G
01A	12A	182B	1A4	1D8GT	1H6GT
4A6G	24X7	183	1A4P	1F4	1J6G
6A3	39 44				

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39c ea.

3V4	6AS5	6G6	6SN7	6Z4	12SA7GT	32	50B5
5U4G	6AT6	6H6	6SJ7	12A8GT	12SF5	33	50C5
5W4GT	6AU6	6H6GT	6SJ7GT	12AT6	12SF7	34	50Y6
5X4G	6A8G	6J5	6SL7GT	12AU6	12SH7GT	35	51
5Y3GT	6A8GT	6J5GT	6SK7GT	12AU7	12SN7GT	35B5	VY-82
5Y4G	6B6	6J6	6SN7GT	12AX7	12SR7GT	35C5	56
1C5	6AB4	6JA6	6J7G	6SQ7GT	12BA6	1619	35W4	57
1C6	6AC4	6BD6	6J7GT	6SR7	12BA7	1629 (eye)	35Z4GT	58
1L4	6AC5	6BE6	6K6GT	6U6G	12BE6	2050	35Z5GT	75
1R5	6AC5GT	6BH6	6K7GT	6U6GT	12FSGT	2051	35Z6GT	76
1S5	6AG5	6BJ6	6K8GT	6U7G	12H6	24A	36	77
1U5	6AK5	6C5	6P5GT	6U7GT	12J5GT	25L6GT	37	78
2A5	6AL5	6C8G	6SA7GT	6V6GT	12J7GT	25X6	38	80
2A7	6AL6	6D6	6SC7GT	6W4	12K7GT	30	39	85
3Q4	6AQ5	6F5GT	6SG7	6X4	12K8GT	31	46	89
3S4	6AR5	6F6GT	6SG7GT	6X5GT	12SH5GT			

69c each

1B3GT	6G5	6Q7	19BG-
2A3	6U5	6R7	19T8
3Q5	19BG-	6SA7	25Z5
6A7	6G	6SL7GT	25Z6GT
6BG6G	50A5	6SN7GT	35L6GT
6E5	807	6V6GT	117Z6GT

49c ea.

1LA4	5Z3	6D8G	6W7G	7G7	10Y	12SQ7GT	41	
1LE3	5Z4	6F5	6Y6G	7H7	12A7	12Z3	42	
1N5GT	6A8	6F8G	6Z7G	7J7	12AT7	14N7	43	
1P5GT	6AC7	6K7G	7A4	7L7	12C8	19T8	50L6GT	
1Q5GT	6AV6	6R7	7A7	7N7	12J5	29	53	
1T5GT	6B4G	6SF5GT	7B6	7Q7	12Q7GT	32L7GT	84 6Z4	
0Z4	1V	6BA7	6Q7GT	7E5	7S7	12SG7	35 51	117Z3
1A5GT	1C5GT	6B8	6T7G	7E6	7T7	12SJ7GT	35L6GT	VR150
1A7GT	2B7	6C6	6T8	7E7	7V7	12SK7GT	36	XXL
1C7G	5V4	6D8	6U7	7F7	7W7	12SL7	40	

59c ea.

1AB5	1LB4	1LN5	2X2	6B7	6L6	12A6	50C6	117Z6GT
1AD5	1LC5	1S4	25Z5	6BF6	6S7G	12BF6	70L7GT	9001
1H5GT	1LC6	2C34	35Z3	6J8G	6SU7GT	14H7	83	XXB
1LA6	1LH4	2V3G	3LF4	6L6G	7C4	45	83	

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.05	ea. 8c
.1	ea. 9c

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.2 mfd.	ea. 6c
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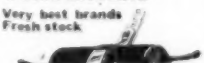

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8—450 V	ea. 21c
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10—450 V	ea. 27c
15—450 V	ea. 29c
20—450 V	ea. 35c
10—450 V	ea. 49c
10—450 V with 20-20— 25 V	ea. 29c
8-8—450 V	ea. 19c
10-10—450 V	ea. 41c
20-20—450 V	ea. 45c

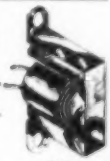
150 Working Volts

15-15—150 V	ea. 29c
20-20—150 V	ea. 29c
20-20-20—150 V	ea. 19c
10-20—150 V	ea. 25c
30-30—150 V	ea. 29c
40-20—150 V	ea. 39c
40-30—150 V-30-20-25 V	ea. 39c
40-40—150 V	ea. 39c
40-40—150 V 20-25 V	ea. 39c
50-30—150 V	ea. 39c
50-50—150 V	ea. 49c
60-60—150 V	ea. 55c
15—150 V	ea. 21c
15—150 V	ea. 21c
20—150 V	ea. 25c
30—150 V	ea. 29c
40—150 V	ea. 29c

25 Working Volts

10—25 V	ea. 16c
20—25 V	ea. 16c
25—25 V	ea. 16c
100—25 V	ea. 16c
20-10-10—150 V Sprague type	ea. 39c
25-25—150 V-200-10 V	ea. 39c

OUTPUT TRANSFORMERS



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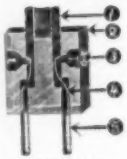
TRANSMISSION LINE ACCESSORIES

MOSLEY TRANSMISSION LINE PLUG



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4. Phosphor spring bronze contact strips. Anchored separately for permanence.
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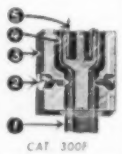

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.1 MFD .29
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1A05, 1T6, 1E5, 1A5 1.23
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ADSON RADIO & ELECTRONICS CO.
221 Fulton Street, New York 7, N.Y.

Photocell

(Continued from page 51)

last ¼ inch at the drilled end. Place the strip inside the jar top, as shown in Fig. 2 (left), with the screw of the banana plug passing through its clearance hole. Fasten the strip and plug with a 6-32 nut. Bend the free portion of the strip slightly upward so as to make contact with the rectifier disc when the latter is placed into position.

(5.) Bend a solder lug into the shape of a wiper contact (See Figs. 2 [left] and 4A), pass a 6-32 screw through its hole, and pass the screw through a ½-inch-diameter bakelite washer. This complete assembly may be seen in Fig. 2 (left).

(6.) Place a rectifier disc into the jar top with its selenium-coated surface outward, and press it down against the metal contact strip previously installed. Then, pass the screw holding the lug and washer through the large clearance hole in the rectifier disc and through the hole in the back of the jar top, holding all of the parts stationary to keep the screw in the exact center of the hole and out of contact with the rectifier disc. Tighten the entire assembly by means of a nut on the outside of the jar top. Be careful that the inner lug does not bite through the selenium coating.

(7.) Place a solder lug on top of the outside back nut and add a second nut to secure this lug. (See Fig. 5).

(8.) Cut a 2-inch-diameter disc of transparent, colorless celluloid or other thin plastic and mount this disc over the open side of the photocell by means of Duco household cement.

Performance of the Unit

After the photocell has been completed, connect it to a d.c. microammeter, 0-1 d.c. milliammeter, or d.c. vacuum tube voltmeter. The banana plug contacts the uncoated rear face of the rectifier plate and must be connected to the positive terminal of the meter. The rear contact lug communicates with the selenium-coated surface and must be connected to the negative terminal of the meter. When light is directed upon the surface of the rectifier plate within the cell, the meter will be deflected upward.

There will, of course, be some variation in results obtained by different experimenters. However, the following data obtained by the author is indicative of performance to be expected: A 60-watt lamp (without lens or reflector) placed about 3 feet from the cell gives a photocell output of 10 millivolts across a 1000-ohm load. In broad daylight (high noon in sunny California) with the cell pointed away from the sun, 0.2 ma. is obtained with the cell connected to a 0-1 d.c. milliammeter (meter internal resistance=100 ohms). Feeding the cell into a Sylvania Type 221 Polymeter (input resistance=17 megohms), the deflection is 0.2 volt away from the sun and 0.3

volt when the cell is pointed toward the sun. Higher outputs may be obtained when employing light bulbs by using a stronger lamp than the 60-watt unit mentioned in the foregoing, and also by concentrating the rays with a lens or reflector.

For higher outputs, several rectifier plates converted into photocell units may be fastened close together on a plate of metal or insulating material and connected in parallel. The parallel connection is preferred to series-connecting the cells, since a shaded series cell tends to offer high resistance to currents produced by illuminated cells in the string. A 4-cell unit of this type constructed by the author gave the following performance: (1.) In strong daylight, but pointing the cell away from the direction of the sun, 0.95 ma. deflection was obtained in a 0-1 d.c. milliammeter. (2.) Illuminated by a 60-watt lamp at a distance of 3 feet, 110 millivolts output was obtained across a load resistance of approximately 1000 ohms.

A Simple Light Meter

One of the simple applications of the home-made photocell is the light (or exposure) meter shown in photograph in Figs. 1 and 3. Fig. 4B is the light meter circuit. The small size of this instrument, made possible by use of a 1-inch 0-100 d.c. microammeter, is apparent from the comparison with a book of matches in Fig. 1.

The instrument is built into a 4⅛ inch x 2 inch x 1⅝ inch metal "chassis box." The single-plate photocell peeps out through a 1⅛ inch-diameter hole cut in one end of the box, as shown in Fig. 3 (left). Interior construction and wiring are visible in Fig. 3 (right).

After completion, the instrument may be calibrated against a factory-made exposure meter, such as the *Weston* or *General Electric* model.

—30—

TELEVISION RECEIVERS AFFECT THERMOSTATS

By STUART COFFE

WHAT appears to be faulty operation of automatic heating systems can sometimes be directly attributed to incorrect placement of TV or radio receivers.

The location of the TV receiver is oftentimes against an inside wall centrally located in the living room where it can be comfortably viewed without moving the furniture. Unfortunately the heating system thermostat is often found on the same wall above the receiver and the heat radiated from the set can cause the thermostat temperature to rise so high that it will not close even though the room becomes uncomfortably cool.

The only satisfactory cure is to move the receiver to another part of the room although a partial cure can sometimes be effected by placing a deflector directly under the thermostat. Care should be taken to see that adequate air circulation is allowed the receiver or premature failure of component parts will result.

—30—

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University MODEL 6201 COAXIAL SPEAKER

CUTAWAY VIEW

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CONTINUOUS POWER: 20 watts of integrated program material

NOMINAL IMPEDANCE: 8-12 ohms

FREQUENCY RESPONSE: 45 to 15,000 cycles

Leading again in PRICE AND QUALITY!

ECONOMY—The Model 6201 is one of the greatest coaxial speaker values ever offered. Despite its economical price, it offers no compromise in efficiency, response, or power handling capacity. A listening test in comparison with higher priced competitive speakers is the most convincing demonstration we can suggest to substantiate these claims.

MANY NEW FEATURES—These include an oversize woofer 2" voice coil capable of extreme excursion for perfect low frequency response, a professional driver—driven tweeter unit with "cobra" shaped horn for clean, wide angle projection of the highs, and a built-in LC type frequency dividing network with a variable attenuator.

UNIVERSAL REPLACEMENT—The self-contained features of the Model 6201 permit rapid, easy replacement of any standard speaker for conversion to high fidelity reproduction. Only two wires to connect and the job is complete. Ample cable is provided for mounting the attenuator control in any convenient location.

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NEW TV RECEIVERS ----------on the Market

"CUSTOM DELUXE 12"

Stewart-Warner's 12½" TV-AM-FM table model receiver is being marketed under the name "Custom Deluxe 12."

This 27 tube set has the company's exclusive "Channel Eye Tuning," a

new "Unipanel" control which reduces the number of operating controls, and an advanced design "Turret Tuner." A simple, quick adjustment of the turret tuner is said to provide reception of the proposed u.h.f. channels without the use of a converter. The receiver covers 535-1650 kc, standard broadcast and 88-108 mc. FM.

Stewart-Warner Corporation is located at 1826 Diversey Parkway, Chicago 14.

19-INCH CONSOLE

A 19-inch television console with a 203 square inch picture has been added to the line of receivers being produced by *The Hallicrafters Company*, 4401 West Fifth Ave., Chicago 24, Illinois.

The new set is available in cordovan mahogany (Model 605) and fruitwood-

finish oak veneer (Model 606) cabinets. Both cabinet designs are "Chinese-influenced."

VIDEON

Reeves Soundcraft Corp. of 10 East 52nd Street, New York 22 has introduced a projection model television receiver for theater and other large-audience applications.

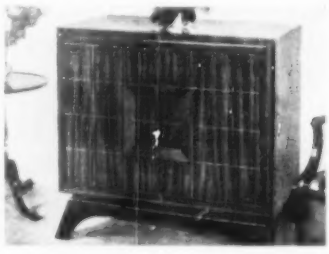
Designated the "Videon" system, the unit provides a 7 by 9 foot image in theater darkness or a 3 by 4 foot picture with average indoor lighting. Projection may be either front or rear according to space requirements, size of the audience, viewing angles, and ambient lighting.

The "Videon" consists of a master-control console, audio and video amplifier units, a video reflector-projector, and a viewing assembly which combines a daylight-type screen with a wide-range sound reproducer.

STARRETT'S "JOHN HANCOCK"

Starrett Television Mfg. Corp. of 601 W. 26th Street, New York has introduced a deluxe 16" combination television console which has been designated "The John Hancock."

Housed in a cabinet of either bleached or natural mahogany, walnut, or ebony with gold striping, the



set has 22K gold-plated knobs on the various controls.

The set uses 36 tubes including 4 rectifiers and the 16" cathode-ray tube. An automatic all-channel station selector covers all TV channels. The picture lock circuit synchronizes and locks the picture in tune with the transmitting station.

In addition to providing television coverage, the receiver offers AM and FM reception, and a deluxe record changer which handles all three types of records.

1950 NATIONAL SET

The *National Company* of Malden, Massachusetts recently introduced part of its 1950 line of television receivers to the public.

One unit, the TV-1225, is a consolette model featuring a 12½" expanded screen picture tube and a 10" speaker. The cabinet is of hand-rubbed mahogany veneer.

Of special interest to service technicians is the manner in which the tube is mounted. Both the kinescope and the deflection yoke assembly are mounted inversely on a wooden slide so that the chassis can be removed without removing the picture tube assembly. To remove the latter, the technician simply takes out two screws and the assembly slides out. The assembly is also mounted at a slight

angle so that the face of the tube is slanted toward the viewer when sitting normally in a chair.

LOW-COST TABLE MODEL

John Meck Industries, Inc. of Plymouth, Indiana has leveled its sights at the low-priced and second-set market with its new 10" table model television receiver.

Designated the XN-752, the set employs 17 tubes and 2 rectifiers, which with the 10" tube gives a full-sized 65 square inch picture. The tubes are newly developed dual and triple section tubes which perform multiple functions in the circuit.

The cabinet is of hand-rubbed mahogany with rounded sides and measures 21x15x19 inches.

TRANS-VUE CONSOLE

The first television receiver in *Trans-Vue Corporation's* 1950 line of video receivers is the "Aristocrat 400" console.

This 12½" model is housed in a cabinet which is available in mahogany, blonde mahogany, or limed oak finish. It features a built-in antenna, eye level, angle-compensated viewing and perma-magnet focalizer. Also featured is the synchro set tuner that enables all circuits for each channel to be adjusted by means of one adjust-

ment screw. Vernier adjustments and multiple knobs are eliminated.

The chassis incorporates the company's u.h.f. adaptor so that when and if new channels in the u.h.f. bracket

SELENIUM RECTIFIERS
— and —
ELECTRONIC COMPONENTS

THREE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-234VAC Type No.	Current	Output 0-250*VDC Price
3B13-4	4 AMP.	$56.00
3B13-6	6 AMP.	81.50
3B13-15	15 AMP.	120.00

CENTER TAPPED RECTIFIERS SINGLE PHASE FULL WAVE

Input 10-0-10VAC Type No.	Current	Output 0-8*VDC Price
C1-10	10 AMP.	$6.95
C1-20	20 AMP.	10.95
C1-30	30 AMP.	14.95
C1-40	40 AMP.	17.95
C1-50	50 AMP.	20.95

RECTIFIER MOUNTING BRACKETS

For Types B1 through B6, and Type C1 ..... $0.35 per set
For Types B13 ..... .70 per set
For Types 3B ..... 1.05 per set

SINGLE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-18VAC Type No.	Current	Output 0-12*VDC Price
B1-250	250 MA.	$0.95
B1-500	500 MA.	1.95
B1-1	1 AMP.	2.49
B1-1X5	1.5 AMP.	2.95
B1-3X5	3.5 AMP.	4.50
B1-5	5 AMP.	5.95
B1-10	10 AMP.	9.95
B1-20	20 AMP.	15.95
B1-30	30 AMP.	24.95
B1-40	40 AMP.	27.95
B1-50	50 AMP.	32.95

Input 0-36VAC Type No.	Current	Output 0-26*VDC Price
B2-150	150 MA.	$0.98
B2-250	250 MA.	1.25
B2-500	500 MA.	1.50
B2-2	2 AMP.	4.95
B2-3X5	3.5 AMP.	6.95
B2-5	5 AMP.	9.95
B2-10	10 AMP.	15.95
B2-20	20 AMP.	27.95
B2-30	30 AMP.	36.95
B2-40	40 AMP.	44.95

Input 0-115VAC Type No.	Current	Output 0-90*VDC Price
B6-150	150 MA.	$1.95
B6-250	250 MA.	2.50
B6-600	600 MA.	5.95
B6-750	750 MA.	6.95
B6-1X5	1.5 AMP.	10.95
B6-3X5	3.5 AMP.	18.95
B6-5	5 AMP.	24.95
B6-10	10 AMP.	36.95
B6-15	15 AMP.	54.95

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We will be pleased to quote on your requirements. Kindly send for our specification form.

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CF-14	3000 MFD	12VDC	$1.69
CF-15	6000 MFD	12VDC	2.95
CF-1	1000 MFD	15VDC	.98
CF-2	2000 MFD	15VDC	1.69
CF-20	2500 MFD	15VDC	1.95
CF-3	1000 MFD	25VDC	1.25
CF-4	2X3500 MFD	25VDC	8.45
CF-5	1500 MFD	30VDC	2.49
CF-6	4000 MFD	30VDC	5.25
CF-7	5000 MFD	35VDC	6.25
CF-8	100 MFD	50VDC	.98
CF-19	500 MFD	50VDC	1.95
CF-16	2000 MFD	50VDC	5.25
CF-21	1200 MFD	90VDC	5.25
CF-9	200 MFD	150VDC	1.69
CF-10	500 MFD	200VDC	5.25
CF-12	125 MFD	350VDC	2.49

Mounting clamps for above capacitors ..... 15c ea.

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All Primaries 115V AC 50-60 Cycles

Type No.	Volts	Amps.	Price
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TXF36-2	36	2	5.95
TXF36-5	36	5	6.95
TXF36-10	36	10	7.95
TXF36-15	36	15	11.95
TXF36-20	36	20	17.95
XFC18-14	18CT	14	5.95

All TXF Types are Tapped to Deliver 32, 34, 36 Volts. XFC Type is Tapped to Deliver 16, 17, 18 Volts Center Tapped.

RECTIFIER CHOKES

Type No.	Hy	Amps.	Dc Res.	Price
HY5	.02	5	25	$3.25
HY5A	.028	5	09	3.95
HY10	.02	10	30	9.95
HY10A	.014	10	.04	7.95
HY15	.015	15	03	11.95
HY20A	.007	20	.02	12.95

Type "A" low resistance chokes are specially suited to circuits requiring excellent voltage regulation.

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Standard Brands

12 Mmfd.	20 Kv	$4.95
50 Mmfd.	32 Kv	8.95

overall length 6½", diameter 2½", terminal diameter ⅝", shpg. wt. 2 lbs.

EDISON THERMO TIME DELAY RELAY

Heater voltage 115 V. Norm. open SPST contacts. 15-30 sec. delay. Contact rating 115 V. 3A., 440 V. 2A. Size 3¼"x3½" diam. Standard 4-spring tube base ..... Ea. 98¢

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.5 Mfd. 400VDC Telephone Type $0.20
2X.1 Mfd. 600VDC Bathtub ..... .39
6 Mfd. 600VDC w/mtg. clamp ..... .79
8 Mfd. 660VAC/2000VDC w/brkts. 3.50
15-15 Mfd. 800VDC Voltage Doubler Type 26F381 w/brkts. 3.95

SPECIAL—LIMITED QUANTITY

Sprague Vitamin Q Photo-Flash Capacitors. 8 MFD—3000 VDC—30 watt/sec. 4½"x3¾"x 1¾". Weight, 1 lb. 12 oz. each. Price ..... **$5.95** ea.
3 for $15.00

ATTENTION!!!
Bulletin No. 713, listing various government and commercial surplus items, is now available upon request.

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Aircraft type panel mounting, amber jewel. Knurled rim controls. "THIS-BRIGHT". Bakelite and aluminum construction. Bulb replaceable from front panel. For single-contact bayonet bulbs, up to 7-3/4 size. Dimensions: 2¼" overall length, ¾" diameter, ¾" panel mtg. hole. IMMEDIATE DELIVERY. 500 to carton, netted.

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Standard Brands—Screw Driver Adjust

	Each	10 for	100 for
7.5 MMFD	$0.29	$2.20	$18.00
25 MMFD	.31	2.40	20.00
50 MMFD	.33	2.60	22.00
100 MMFD	.41	3.40	30.00
140 MMFD	.49	4.20	38.00

DC POWER SUPPLY

Limited quantity—Gov't Surplus

Ready to operate. Full-wave bridge, copper-oxide rectifier, heavy-duty multi-tapped transformer. Input: 85-95-105-115 VAC 50-60 cps. Output: 2.5-28-28-32-36 VDC at 5 amperes, unfiltered.

For wall or bench mounting. Overall dimen. 9"x8¾"x8½" high. Shpg. wt. 30 lbs. Tested and guaranteed **$36.00**
Filter kit, 2% ripple $6.65

DIEHL MOTOR

Fan duty, brushless induction type motor for 60 cycle, 110 volt operation. For 115 VAC 60 cycles, 40 watts, 1800 RPM, shaft ¼" diam. 1½" long. Noiseless ball-bearings, heavy cast construction. Brand new **$4.50**

RECTIFIER KIT No. 612-10

6 and 12 VDC at 10 Amps.

This unit will deliver unfiltered direct current for operation of motors, dynamotors, solenoids, electroplating, battery charging and similar equipment.

The two output voltages can be used simultaneously, and can be varied above and below their nominal ranges.

Complete with schematic diagram and instructions. Shpg. wt. 12 lbs. **$15.95**

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1 section choke input, 10% ripple **$9.64**
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Attractive, rugged, and reasonably priced. Moving coil solenoid type with accuracy within 5%.
0-5 Amperes D-C
0-12 Amperes D-C ..... Any range $2.49 each
0-15 Volts D-C

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All prices subject to change without notice.
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WESTERN ELECTRIC BLOWER

(KS58881—Brand New)—Heavy-duty Sirocco type blower, capacitor start, 1/40 H.P., 3400 RPM, 115 VAC, 60 cycles. Displaces 84 C.F.M. Extremely quiet operation. Opening 2¾" overall size 7½" long, 6" diam. Moisture and fungus resistant. With cutter for shpg. wt. 15 lbs. Quant. limited **$13.95**

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Sirocco type, displaces 100 C.F.M. 115 VAC, 60 cps. Moisture and fungus resistant. Flange diameter 4". Overall size 7½"x5". Removed from equipment. Tested and guaranteed **$9.95**

Adjustable right angle aluminum extension tube to fit flange ..... **98¢**

WESTINGHOUSE AIRCRAFT MOTOR

Brand new—24 VDC or AC reversible on both. 1/50 H.P. 4800 RPM continuous duty. Length of shaft 1⅜". Dimensions: 3¼"x2¼"—shaft ¼" diam. by ⅝" long. Price **$2.95**

Reversing switch with "off" position. Each ..... 79¢

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Brand New Immediate Delivery **TUBES** Individually Cartoned Guaranteed

SPECIAL QUANTITY DISCOUNT OFFER
Order 25 or More Assorted Tubes and Deduct 5c from the Price of Each Tube.

15c Each

2C26, 2C34, RK34, 1G26, 2G44, 2C33, 2G34, E1148, VT52

19c Each

1G44, VR91, R99

29c Each

2A7, 2X2, 6C4, 6SH7GT, 6U7G, 7Y4, 12A6, 12A8GT, 12F5GT, 12H6, 26, 36, 950, 957, 6011, VT80, HY615, RK72, RK872, RK873, VT95

39c Each

1A3, 1U4, 1U5, 1V, 2A6, 6A6, 5U4G, 5W4, 5Y3GT, 5Y4G, 6A84, 6AH6, 6AT6, 6AU6, 6BA6, 6BE6, 6C5GT, 6C6

6F5G, 6F5GT, 6H6GT, 6J7, 6N6GT, 6K7G, 6K7GT, 6N4, 6SA7GT, 6SD7GT, 6SF7, 6SJ7, 6SK7GT, 6SQ7GT, 6V6G, 6V6GT, 6X4, 6X5GT, 12AU6, 12AV6, 12AX7, 12Z3, 12J7GT, 12K7GT, 12Q7GT, 12SA7GT, 12SF5, 12SH7, 12SK7GT, 12SL7GT, 12SN7GT, 12SQ7GT, 19T8, 24A, 25Z6GT, 27, 32, 35 5Z, 35A5, 35L6GT, 35W4, 35Z5, 38, 41, 47, 50B5, 57, 76, 78, 80, 83, 84

45c Each

1B3 28B

1L4, 1R5, 1S5, 1T5GT, 2A5, 2B6, 2B7, 6AL5, 6B8, 6Q7

6F8G, 6G6G, 6P5GT, 6S7GT, 6SL7GT, 6SN7GT, 6S7GT, 6V6, 6Y6G, 7A4, XXL, 7A5, 7B8, 7E5, 1201, 7F7, 12AT6, 12AU7, 12BA6, 12BE6, 12SJ7GT, 12Z3, 14N7, 25L6GT, 32L7GT, 34, 35Y4, 35Z4GT, 43, 46, 53, 56, 11723

50c Each

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6AC7 1852, 6AG7, 6AK5, 6AQ5, 6BG6G, 6B8, 6C6, 6F8G, 6L6G, 6T7G, 7A7

7C5, 7F7, 7Q7, 12BD6, 12C8, 14B6, 50C5, 50L6, 80M1, 350B, 7S

89c Each

0A3, 0B3, 1LA4, 1LC6, 1LD5, 1LE3, 1LH4, 1LN5, 1N6G, 1T4, 5V4G, 5AR4/GZ, 6AB7, 6AG5, 6B4, 6BF6, 6BG6G, 6BH6, 6J5, 6JAG, 6W4, 6X4, 6Y3, 12A7, 12AT7, 14A7, 14Q7, 14R7, 32, 50A5, 70L7GT

69c Each

6AC7 1852, 6AG7, 6AK5, 12Z3GT

89c Each

1B3GT 8016, 8298

MINIMUM ORDER $2.50. Send 25% deposit for all C.O.D. shipments. Include sufficient postage; excess will be refunded. Orders without postage will be shipped express collect. All prices F.O.B. New York City.

NEW RECEIVING TUBE INTERCHANGEABILITY CHART

Very latest . . . complete data on direct interchangeability. It's SENCO'S way of greeting New Customers and thanking old ones. . . . It's yours for the asking.

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Radio Men Who Know **SAVE AT SENCO**

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71 WEST BROADWAY NEW YORK 7, N. Y.

are opened no revision or changes in circuitry will be required.

The sets are being turned out at the company's plant at 1139 S. Wabash Ave., Chicago 5, Illinois.

TV-AM-PHONO MODEL

Admiral Corporation of Chicago is offering its Models 24X15 and 24X16 television-radio-phonograph combina-

tions as the answer to the demand for a complete home entertainment unit at low cost.

The set provides a full-vision 10" screen, built-in directional antenna, standard AM radio, and an automatic record player which will handle all three types of recordings. The Model 24X15 is the walnut finish set while the Model 24X16 is the same set but in mahogany finish.

DU MONT'S "CANTERBURY"

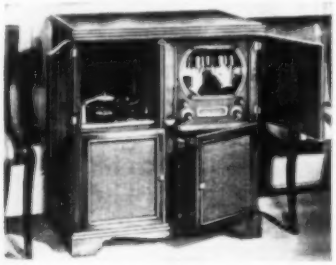
The new 12½ inch console television receiver introduced recently by *Allen B. Du Mont Laboratories, Inc.*, Passaic, New Jersey will be marketed under the name "Canterbury."

Featuring reception on all channels, the new unit provides 85 square inches of picture material. In addition, the "Canterbury" incorporates full-range FM and a record player attachment. The cabinet is of Hepplewhite design and is finished in mahogany veneers.

The receiver has 25 tubes plus 5 rectifiers. The company's "Local-Distant" switching arrangement for increased sensitivity on distant or weak stations is also included in this model.

SIX-WAY CONSOLE

The "top of the line" unit being introduced by *Sylvania Television* is a



six-way mahogany console combination, the Model 076.

Colonial Radio Corp., wholly owned subsidiary of *Sylvania Electric Products Inc.*, is producing the new line of receivers.

The Model 076 features a 10 inch picture tube and 63 square inch screen, all 12 channel reception, AM-FM reception with a 10 inch speaker and balanced tone control, in addition to a three-speed automatic record changer for all types of records, and a built-in antenna.

The console is housed in a mahogany finished cabinet of Georgian design. The cabinet measures 34⅝x31x21⅝ inches.

ANNIVERSARY MODEL

In order to commemorate 25 years in the radio receiver field, *Stromberg-Carlson Company* of Rochester, New York has placed on the market a "Silver Anniversary" television receiver, the Model TC 125 LM2.

A console model with an 89 square

inch viewing screen on a 12½ inch picture tube, the new set is housed in a hand-rubbed, striped Honduras mahogany veneer cabinet. Bronze tuning controls are conveniently located at one side of the picture tube. The receiver has a 12 inch PM speaker and a built-in antenna system. A phono jack in the rear of the chassis will accommodate any type record changer unit. The built-in antenna system for both low and high band television channels is standard equipment on this model.

"THE BEAUMONT"

A custom-built television consolette with a cabinet of genuine mahogany is *Mattison Radio and Television Corporation's* latest offering to the public.

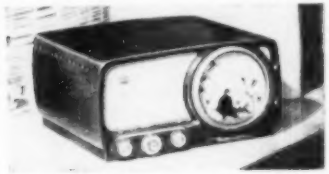
Known as "The Beaumont," this set measures 43x25x23 inches and is available in mahogany or bleached mahogany finishes. The receiver has a 31 tube, high-voltage chassis which incorporates the *RCA* 630 circuit. Also featured is the exclusive "Reflecto-Circle" which is actually a part of the cabinet and serves to eliminate dead areas and utilizes the entire picture tube surface.

The company has headquarters at 220 Fifth Avenue in New York, New York.

7-INCH RECEIVER

Motorola Inc. of Chicago is currently marketing a 7-inch television receiver which will retail in the low-price field.

A high voltage tube which was developed especially for *Motorola* is said to give great brilliance, clarity, and



picture stability. The set is operated through three simple controls.

The unit weighs 25½ pounds and may be carried from room to room without difficulty.

DEWALD TABLE MODEL

Dewald Radio Manufacturing Corp. of 35-15 37th Avenue, Long Island City 1, N. Y., is currently marketing a direct-view table model receiver which features a 16 inch tube.

Designated the Model DT-160, this set provides all-channel coverage, a 145 square inch screen, a built-in an-

tenna, illuminated channel marker, a 22-tube circuit including 2 rectifiers and a damper tube, oversized power transformer, full wide-angle vision, and a large electrodynamic speaker.

NEW PILOT MODEL

Pilot Radio Corporation, 37-06 Thirty-Sixth Street, Long Island City 1, New York is introducing the Model TV-123 to mark its 21st year in television.

The new model has a 12½ inch picture tube and a built-in antenna. In addition, the receiver will provide FM reception and a phono-jack plug-in to which any phonograph can be connected.

Although technically a table model,

a coordinated supporting cabinet base can be used to transform the set into

PERMANENT MAGNET FIELD DYNAMOTORS —POWER SUPPLY

POWER SUPPLY:
12 or 24 Volt DC input; output 275 Volt 110 MA.; 500 Volt 50 MA. Completely filtered and housed in metal case. These units were originally used with Mark II No. 19 radio sets and cost Govt. $150.00. The dynamotors will operate on 6 VDC at approx. half the voltage, thereby giving you a good motor for car shaver or AC-DC radio operation, and a power supply for your mobile receiver from your 6 Volt auto battery. This power supply unit contains all of the items pictured and described in the column to the right. Size: 8" H x 6" W x 10" D. Shipping Weight: 42 lbs.
Complete Unit—Order No. BPS #3 $5.00

EACH UNIT CONTAINS THE FOLLOWING PARTS WHICH MAY BE PURCHASED SEPARATELY:

1—Dyn. 12/24 input; output 275 V 110 MA.	$3.95
1—Dyn. 12/24 input; output 500 V 50 MA.	2.95
8—1 500 V Oil Tubular Cond.	1.00
2—1 1000 V Oil Tubular Cond.	.50
2—15 MFD. 400 V DC Elect. Cond.	.80
1—DPST 15 A. Toggle Switch	.40
1—SPDT 20 A. Toggle Switch	1.00
2—Fuses—Holders & ¼ A. Fuses	.30
1—Pilot Light 12 V & Holder	.20
5—Filament & RF Chokes	1.00
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Ideal for antenna direction indicator to remote position. Complete with Autosyn Trans., 5" 1-81 Indicator, Transformer, and instructions.
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Autosyn Trans. only: $2.95 Plug (1-51) $1.00

CONDENSER ASS'Y.
5 Gang with vernier tuning, 25 MMFD. to 450 MMFD. each section. Size: 2¾ x 2¾ x 3. $2.95
CONDENSER—3 Gang, 5 MMFD. to 450 MMFD. each section. Size: 2"x3¼"x 3. $1.95

NEW TRANSFORMERS And CHOKES

ALL FOLLOWING TRANSFORMERS—CASED 115 V.A.C. 60 CYCLE INPUT:

OUTPUT: 250-0-250 V.A.C. (600 V.D.C. after choke input filter at 250 MA.; Includes 6.3 V.A.C. winding at 5 amps. and 5.0 V.A.C. winding at 4 amps. NH-106 $7.95
OUTPUT: 625-0-625 V.A.C. (500 V.D.C. after choke input filter at 250 MA.; Includes 6.3 V.A.C. winding at 5 amps. and 5.0 V.A.C. winding at 4 amps. NH-107 $7.35
OUTPUT: 600-0-600 V.A.C. at 250 MA.; 12 V.A.C. at 2 amps.; 12 V.A.C. at 3 amps. and 5 V.A.C. at 3 amps. Designed for Army surplus transmitters. NH-108 $6.90
OUTPUT: 250-0-250 V.A.C. at 60 MA., 24 V.A.C. at 5 amps.; 6.3 V.A.C. at 6 amps. Designed for Army surplus Receivers. NH-109 $3.00
OUTPUT: 6.3 V.A.C. at 6 amps. NH-110 $2.25
OUTPUT: 24 V.A.C. at 2 amps. NH-111 $2.25
OUTPUT: 2.5 V.A.C. at 10 amps. center tapped and shielded. Open frame mounting insulated for continuous operation at 5,000 volts. NH-112 $4.20

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NH-117—8 Henries at 700 MA. filter choke, 7,500 volt insulation $14.95
NH-118—5-20 Henries at 700 MA. swinging choke, 7,500 volt insulation $14.95
NH-121—15 Henries at 250 MA. filter choke, 1,500 volt insulation $4.95

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BC-454 RECEIVER—3—6 MC		8.95
Dual or Triple Receiver Rack		1.50
BC-456 Trigger Cable, Box		1.95
TRANSFORMER (Comm. Rec. See NH-109 above (New)		3.00
	USED:	NEW:
BC-459 TRANSMITTER—7—9 MC	$12.95	
BC-457 TRANSMITTER—4—5.3 MC	6.95	$8.95
BC-458 TRANSMITTER—5.3—7 MC	6.95	8.95
T-18 TRANSMITTER—2.1—3 MC	8.95	
BC-450 Trans. Modulator Re-losue	1.95	2.95
Dual Transmitter Rack		1.50
BC-451 Trans. Control Box		1.50
BC-442 Antenna Relay Box with Cond.		2.95
TRANSFORMER (Comm. Trans. See NH-108 above (New)		6.90
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PE-125 POWER SUPPLY FOR 223 Trans.		
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TRANSFORMERS—110 V. 60 CYCLE PRIMARIES:

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24 V. 1 amp.	1.95	24 V. .5 amp.	1.50
Sec. 26 VAC. 2.5 amps.			2.95
Sec. 14-14 or 28 V. ½ or 15 amps.			4.95

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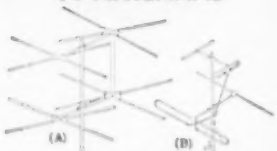

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"ACADEMY" BY MARS

One of the interesting features of the new "Academy" model video receiver recently introduced by *Mars Television Inc.* of Long Island City, is

the removable front panel which permits the insertion of the picture tube without dismantling the back of the set.

The set uses 31 tubes and features a clear vision control panel. The receiver is housed in a hand-rubbed mahogany finished cabinet measuring 41x25x24 inches. —30—

Modern TV Receivers
(*Continued from page* 47)

amplifier, amplified and transferred to the deflection coils.

Servicing And Alignment of A.F.C. System. Failure of the a.f.c. system to function properly will immediately reveal itself by one of the symptoms shown in Fig. 6. When the frequency of the horizontal oscillator is not controlled, it will, in general, differ from the frequency of the incoming sync pulses. When this happens, the image will appear either as shown in Fig. 6 (left) or (right). When correcting this condition, rotate the hold control (which is either on the front or rear panel of the receiver). If the picture snaps back into proper position, then the hold control was improperly set. As a test to determine whether any other defect exists, momentarily remove the signal by turning the contrast control fully counter-clockwise and returning it to the operating position. The picture should immediately pull back into sync. Turn the horizontal hold control to the extreme clockwise position and to the extreme counter-clockwise position. The picture should remain in horizontal sync. If the receiver passes these tests, the horizontal oscillator is correctly aligned.

In dealing with a.f.c. systems, the service technician should be aware of the fact that there is a difference between the pull-in range and the hold-in range. Once in sync, the circuit will hold about 50% to 100% more variation in frequency than it can pull in. Thus, suppose that the hold control is in the extreme clockwise or counter-clockwise position and the set is turned on. It is entirely possible that the horizontal oscillator will not be locked in by the incoming pulses. However, once lock-in is effected, then rotating the hold control completely will generally not cause it to fall out of sync.

If the picture is not in sync and variation of the hold control does not correct this condition, try adjusting the slug of the winding on transformer T_1 which is connected to the grid of V_6. If neither control is effective in re-establishing lock-in, then the following tests should be made, preferably in the order indicated:

1. Change tubes V_1 and V_3 (Fig. 3).
2. Check the waveforms at the plates of V_{5a} and V_{5b} (pins 2 and 7 of a 6AL5). See Fig. 7.
3. Check the waveforms at the plate and cathode of V_6. See Fig. 8.
4. Check the waveforms at the plate of V_{7a}. See Fig. 5 (left).
5. Make resistance and voltage checks at any point where the waveform is not as specified.

Another defect that sometimes occurs in this system is the appearance of a stationary picture, but with the horizontal blanking bar visible on the

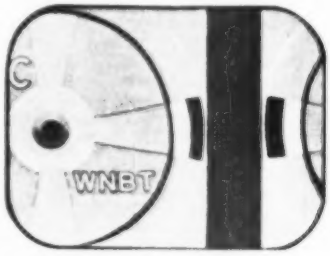
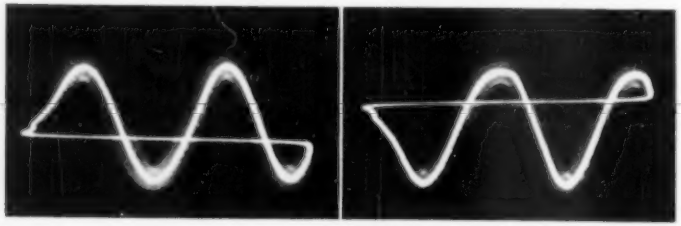


Fig. 9. The appearance of the image when the slug in the T_1 winding (shown in Fig. 3) is misadjusted.

Fig. 8. Waveforms at the plate (left) and the cathode (right) of V_6 in Fig. 3.



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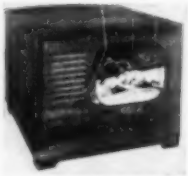

Sparkling new Telekit 10-B has 52-inch screen. Brand new compact lay-out has video tube mounted on chassis. Big illustrated easy-to-follow instruction book guides you step by step through easy assembly. No special knowledge of television is required. All you need is a soldering iron, pliers, and screw driver. 10-B kit can be used with 12 ½, 15, 16 inch tubes. Telekit 10-B, $69.95. 10-B Telekit cabinet $15.95 and $24.50. Satisfactory Telekit performance guaranteed by Factory Service Plan.

Write for catalog listing 10-B and 7-B Telekits. New 7-B Telekit for 7-inch tube, $49.95. 7-B cabinet, $13.95 and $24.50.

TELEKIT BOOSTER 12.95

This Telekit booster will bring in TV signals bright and clear in the fringe areas. Has a 20 times boost on all TV channels. NOT A KIT. Completely assembled. With tubes. Works with Telekit or any TV receiver.

13 CHANNEL TUNER 12.95

This compact front end has a stage of RF for extra distance. Made to conform with Telekit or any TV set having a video I.F. of 25.75 Mc. Complete with tubes, pre-wired, pre-assembled. Only four connections to make.

Write for catalog of Telekit antennas, boosters, television kits tuners, television parts and tubes.

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screen. See Fig. 9. This indicates that the slug in the winding of T_1 which connects to V_{1a} and V_{1b} is not properly positioned. Adjust this slug until the blanking bar moves to the right and off the raster.

The foregoing adjustments pertain only to this particular sync system. Thus, in some systems to be described presently, it is normal for the picture to drop out of sync at the extreme clockwise and counter-clockwise positions of the hold control. In this system this is generally not true. When doing repair work on any of the a.f.c. systems, it is necessary for the service technician to know what represents normal operation and what does not. It is the purpose of these articles to make these facts known.

(To be continued)

Converting TR-1

(Continued from page 49)

tion from the circuits is appreciable, and under some conditions there apparently can be standing waves on the panel itself.

Calibration

Frequency calibration was derived from a pair of Lecher wires and the harmonics of a two-meter transmitter on 145 mc., with the aid of a *Little Gem* crystal wavemeter. The Lecher wires were made simply by folding seven feet of #14 wire in the middle and anchoring it to a lath with four small insulators. The wires are spaced one inch and the lath is ruled off in inches from a yardstick. A machine screw makes a convenient shorting bar. No turnbuckles or springs were included because the availability of crystal harmonics made high accuracy unnecessary.

The *Little Gem* wavemeter consists of a small split-stator condenser mounted as close as possible to a four-prong coil socket. The pick-up side of the dual hairpin coil feeds a germanium crystal diode and a 100 microampere meter. The whole circuit, shown in Fig. 4D, is mounted in a 4x4x2 metal box, with only the condenser shaft grounded.

After the detector was operating, the two-meter transmitter was turned on at 145 mc. and the receiver tuned through its range. A series of signals were found which proved to be the harmonics of the 8.056 mc. crystal oscillator. On one of these at the third harmonic of the final, or 435 mc., microphone feedback appeared readily. This one identified the center of the band, and approximate limits were indicated by the second harmonic signal each way. These three points at center and edges were checked with the Lecher wires and found to agree, with readings at 13, 13½, and 14 inches. The *Little Gem* was then calibrated from the receiver and used to determine safe transmitter dial settings for in-band radiation. These dial settings must, of course, be found for the particular antenna and adjustment of antenna coupling to be used in actual transmission. —30—

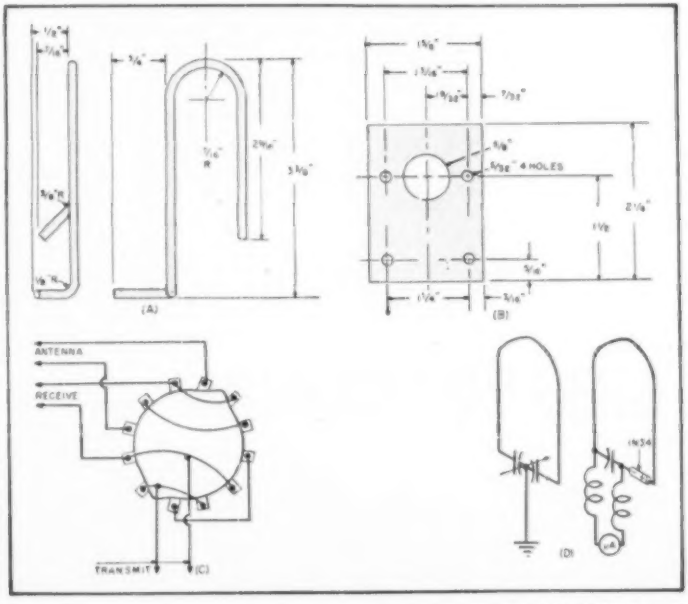

Fig. 4. (A) Detector line elements, right and left required, right shown (see text for details on twisting). Made from $\frac{1}{8}$" copper rod or wire. (B) Detector socket mounting, drilled for Millen socket. Made from $\frac{1}{16}$" phenol fabric. (C) Antenna switch connections. (D) Little Gem crystal wavemeter.

Beginning Amateur

(Continued from page 42)

able courses piecemeal, instead of having to dig into the family finances for a big chunk of money all at once.

Some courses start really at the bottom. They are written on the assumption that the student knows absolutely nothing about radio but wants to learn. Even a ham with a few months of experience can usually learn something from the early lessons, and of course they build up gradually. Other courses are more or less "refreshers," intended for service technicians, station operators, etc., who want to branch out a bit. The advanced lessons are on the engineering level, with enough math included to keep the student awake for many nights.

Would-be service technicians, station operators, etc., are not the only people who benefit from correspondence courses. They are taken with great profit by salesmen, advertising men, manual training teachers, and many others who are connected directly or indirectly with radio and find it desirable to know something about its technical aspects.

Wherever a ham goes in the radio business, he'll find other hams ready and willing to help him. And they turn up in the most unexpected places, sometimes even in the office of the president of the company. —30—

DDT DAMAGES PLASTICS

SEVERAL common types of aerosol and liquid DDT sprays and solutions will adversely affect certain types of plastics. Upon contact, the liquid or spray will turn milky or fog meter glass dials and other clear plastics. It further tends to roughen or pit the plastic, ruining cabinets and cases.

DDT, while of value in insect control, should be kept away from plastics or plastic trimmed items.

To date, no good method of repair has been found except to buff and polish the surface below the level to which the plastic has been affected . . . J.W.S.

"No, no, Ed. . . . try it a little to the left of the chimney!"

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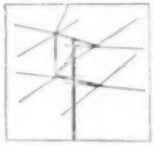

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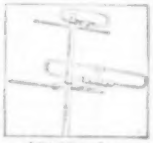

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Rugged, small size, heat resistant, non-inflammable and completely insulated.	.01	600	18c
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	.0005	6000	81c
	.001	6000	81c
	.002	6000	8½c
	.0005	10000	90c

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INSULATORS 3½c each

300 ohm; screw-type. 100 ..... $2.75
1000 ..... $24.75

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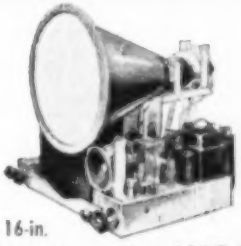
6-ft. Aluminum Extension Masts 75c
12-ft. Heavy Duty Aluminum Mast $3.49

CHIMNEY QUICK MOUNT $1.45

Steel, heavily plated. Two complete easily mounted brackets supporting masts up to 1⅝" diam. All strap and hardware included.



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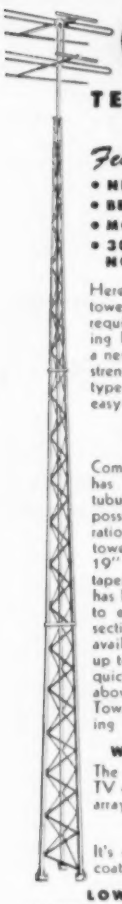

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It's durably finished with two coats of aluminum enamel.

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OSCILLOSCOPE QUIZ

By ED BUKSTEIN
Northwestern Vocational Institute

(For answers see page 152)

Because television is taking up a greater portion of the service technician's time than ever before, it is well to check up and see just how well acquainted you are with your oscilloscope and its operation. All questions refer to the diagram shown.

1. Switch 1 serves as the *(a) sweep frequency control (b) horizontal gain control (c) attenuator (d) vertical centering control.*

2. Tube V_1 is a *(a) cathode follower (b) grounded grid amplifier (c) sawtooth generator (d) horizontal amplifier.*

3. Potentiometer R_1 is the *(a) fine sweep control (b) coarse sweep control (c) horizontal gain control (d) vertical gain control.*

4. Inductance L_1 is used to compensate for *(a) low frequency gain (b) high frequency gain (c) saw-tooth linearity (d) pattern drift.*

5. The combination of R_1-C_1 serves to increase the *(a) low frequency response (b) saw-tooth amplitude (c) high frequency response (d) external synchronization.*

6. When switch 2 is in the position shown, the scope is being used with *(a) external synchronization (b) internal synchronization (c) 60 cycle synchronization (d) no synchronization.*

7. Potentiometer R_5 controls the *(a) vertical gain (b) horizontal gain (c) vertical centering (d) sync amplitude.*

8. Tube V_7 is used as the *(a) cathode follower (b) sweep generator (c) deflection amplifier (d) wide-band amplifier.*

9. Switch 3 is the *(a) coarse sweep control (b) fine sweep control (c) vertical attenuator (d) horizontal centering.*

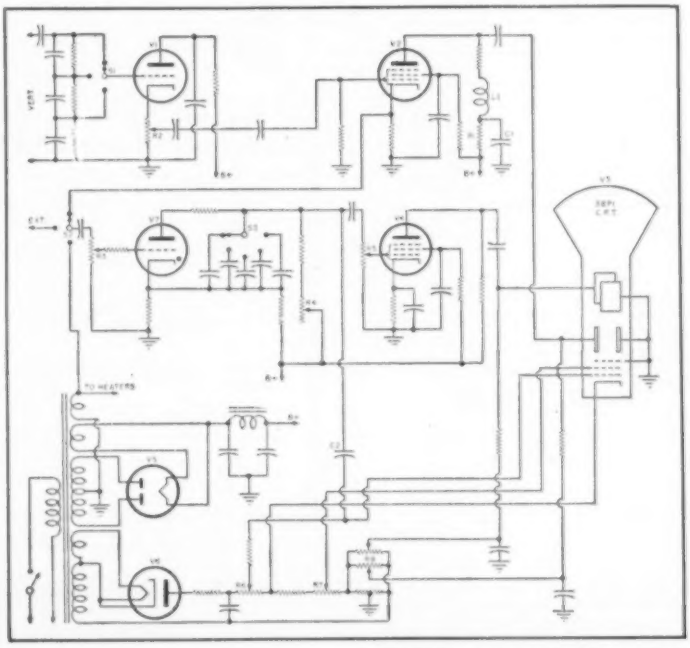
10. R_7 controls the *(a) focus (b) contrast (c) brightness (d) sweep frequency.*

11. R_8 is the *(a) vertical gain control (b) horizontal gain control (c) focus control (d) intensity control.*

12. V_8 is the *(a) cathode follower (b) high-voltage rectifier (c) low-voltage rectifier (d) full-wave rectifier.*

13. The voltage at the plate of the

Fig. 1.



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1D5	.35	6AS6	1.00
1D7	.35	6AS7	1.00
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1E5	.35	6AU5	1.00
1E7	.35	6AU6	.35
1F4	.35	6AV5	1.00
1F5	.35	6AV6	.35
1F6	.35	6B4	1.00
1F7	.35	6B5	1.00
1G4	.35	6B6	.35
1G5	.35	6B7	.35
1G6	.35	6B8	.35
1H4	.35	6BA6	.35
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1L5	.35	6BE6	.35
1L6	.35	6BE7	1.00
1N5	.35	6BF5	1.00
1P5	.35	6BF6	.35
1Q5	.35	6BG6	1.00
1R5	.35	6BH6	.35
1S4	.35	6BH7	1.00
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1T4	.35	6BJ6	.35
1U4	.35	6BJ7	1.00
1U5	.35	6BK5	1.00
2A3	1.00	6BK7	1.00
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2A6	.35	6BL7	1.00
2A7	.35	6BN5	1.00
2B7	.35	6BN6	.35
2C5	.35	6BQ5	1.00
2C26	.35	6BQ6	.35
2D21	.35	6BQ7	1.00
2E5	.35	6BR5	1.00
2E22	.35	6BR7	1.00
2E24	.35	6BS5	1.00
2E26	.35	6BS6	.35
2E30	.35	6BS7	1.00
2E32	.35	6BT5	1.00
2E35	.35	6BT6	.35
2E36	.35	6BT7	1.00
2E42	.35	6BU5	1.00
2E46	.35	6BU6	.35
2E50	.35	6BU7	1.00
2E51	.35	6BV5	1.00
2E52	.35	6BV6	.35
2E54	.35	6BV7	1.00
2E56	.35	6BW5	1.00
2E63	.35	6BW6	.35
2E64	.35	6BW7	1.00
2E66	.35	6BX5	1.00
2E74	.35	6BX6	.35
2E75	.35	6BX7	1.00
2E76	.35	6BY5	1.00
2E78	.35	6BY6	.35
2E79	.35	6BY7	1.00
2E80	.35	6C4	1.00
2E81	.35	6C5	1.00
2E82	.35	6C6	.35
2E83	.35	6C7	.35
2E84	.35	6C8	.35
2E85	.35	6CA6	.35
2E86	.35	6CA7	1.00
2E87	.35	6CB6	.35
2E88	.35	6CB7	1.00
2E89	.35	6CD6	.35
2E90	.35	6CD7	1.00
2E91	.35	6CE5	1.00
2E92	.35	6CE6	.35
2E93	.35	6CE7	1.00
2E94	.35	6CF5	1.00
2E95	.35	6CF6	.35
2E96	.35	6CF7	1.00
2E97	.35	6CG5	1.00
2E98	.35	6CG6	.35
2E99	.35	6CG7	1.00
2E100	.35	6CH6	.35
2E101	.35	6CH7	1.00
2E102	.35	6CJ5	1.00
2E103	.35	6CJ6	.35
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2E107	.35	6CK7	1.00
2E108	.35	6CL5	1.00
2E109	.35	6CL6	.35
2E110	.35	6CL7	1.00
2E111	.35	6CM5	1.00
2E112	.35	6CM6	.35
2E113	.35	6CM7	1.00
2E114	.35	6CN5	1.00
2E115	.35	6CN6	.35
2E116	.35	6CN7	1.00
2E117	.35	6CQ5	1.00
2E118	.35	6CQ6	.35
2E119	.35	6CQ7	1.00
2E120	.35	6CR5	1.00
2E121	.35	6CR6	.35
2E122	.35	6CR7	1.00
2E123	.35	6CS5	1.00
2E124	.35	6CS6	.35
2E125	.35	6CS7	1.00
2E126	.35	6CT5	1.00
2E127	.35	6CT6	.35
2E128	.35	6CT7	1.00
2E129	.35	6CU5	1.00
2E130	.35	6CU6	.35
2E131	.35	6CU7	1.00
2E132	.35	6CV5	1.00
2E133	.35	6CV6	.35
2E134	.35	6CV7	1.00
2E135	.35	6CW5	1.00
2E136	.35	6CW6	.35
2E137	.35	6CW7	1.00
2E138	.35	6CX5	1.00
2E139	.35	6CX6	.35
2E140	.35	6CX7	1.00
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2E142	.35	6CY6	.35
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2E145	.35	6D5	1.00
2E146	.35	6D6	.35
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2E163	.35	6DF7	1.00
2E164	.35	6DG5	1.00
2E165	.35	6DG6	.35
2E166	.35	6DG7	1.00
2E167	.35	6DH6	.35
2E168	.35	6DH7	1.00
2E169	.35	6DJ5	1.00
2E170	.35	6DJ6	.35
2E171	.35	6DJ7	1.00
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2E179	.35	6DM6	.35
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2E189	.35	6DR7	1.00
2E190	.35	6DS5	1.00
2E191	.35	6DS6	.35
2E192	.35	6DS7	1.00
2E193	.35	6DT5	1.00
2E194	.35	6DT6	.35
2E195	.35	6DT7	1.00
2E196	.35	6DU5	1.00
2E197	.35	6DU6	.35
2E198	.35	6DU7	1.00
2E199	.35	6DV5	1.00
2E200	.35	6DV6	.35
2E201	.35	6DV7	1.00
2E202	.35	6DW5	1.00
2E203	.35	6DW6	.35
2E204	.35	6DW7	1.00
2E205	.35	6DX5	1.00
2E206	.35	6DX6	.35
2E207	.35	6DX7	1.00
2E208	.35	6DY5	1.00
2E209	.35	6DY6	.35
2E210	.35	6DY7	1.00
2E211	.35	6E4	1.00
2E212	.35	6E5	1.00
2E213	.35	6E6	.35
2E214	.35	6E7	.35
2E215	.35	6E8	.35
2E216	.35	6EA6	.35
2E217	.35	6EA7	1.00
2E218	.35	6EB6	.35
2E219	.35	6EB7	1.00
2E220	.35	6EC6	.35
2E221	.35	6EC7	1.00
2E222	.35	6ED5	1.00
2E223	.35	6ED6	.35
2E224	.35	6ED7	1.00
2E225	.35	6EE5	1.00
2E226	.35	6EE6	.35
2E227	.35	6EE7	1.00
2E228	.35	6EF5	1.00
2E229	.35	6EF6	.35
2E230	.35	6EF7	1.00
2E231	.35	6EG5	1.00
2E232	.35	6EG6	.35
2E233	.35	6EG7	1.00
2E234	.35	6EH6	.35
2E235	.35	6EH7	1.00
2E236	.35	6EJ5	1.00
2E237	.35	6EJ6	.35
2E238	.35	6EJ7	1.00
2E239	.35	6EK5	1.00
2E240	.35	6EK6	.35
2E241	.35	6EK7	1.00
2E242	.35	6EL5	1.00
2E243	.35	6EL6	.35
2E244	.35	6EL7	1.00
2E245	.35	6EM5	1.00
2E246	.35	6EM6	.35
2E247	.35	6EM7	1.00
2E248	.35	6EN5	1.00
2E249	.35	6EN6	.35
2E250	.35	6EN7	1.00
2E251	.35	6EQ5	1.00
2E252	.35	6EQ6	.35
2E253	.35	6EQ7	1.00
2E254	.35	6ER5	1.00
2E255	.35	6ER6	.35
2E256	.35	6ER7	1.00
2E257	.35	6ES5	1.00
2E258	.35	6ES6	.35
2E259	.35	6ES7	1.00
2E260	.35	6ET5	1.00
2E261	.35	6ET6	.35
2E262	.35	6ET7	1.00
2E263	.35	6EU5	1.00
2E264	.35	6EU6	.35
2E265	.35	6EU7	1.00
2E266	.35	6EV5	1.00
2E267	.35	6EV6	.35
2E268	.35	6EV7	1.00
2E269	.35	6EW5	1.00
2E270	.35	6EW6	.35
2E271	.35	6EW7	1.00
2E272	.35	6EX5	1.00
2E273	.35	6EX6	.35
2E274	.35	6EX7	1.00
2E275	.35	6EY5	1.00
2E276	.35	6EY6	.35
2E277	.35	6EY7	1.00
2E278	.35	6F4	1.00
2E279	.35	6F5	1.00
2E280	.35	6F6	.35
2E281	.35	6F7	.35
2E282	.35	6F8	.35
2E283	.35	6FA6	.35
2E284	.35	6FA7	1.00
2E285	.35	6FB6	.35
2E286	.35	6FB7	1.00
2E287	.35	6FC6	.35
2E288	.35	6FC7	1.00
2E289	.35	6FD5	1.00
2E290	.35	6FD6	.35
2E291	.35	6FD7	1.00
2E292	.35	6FE5	1.00
2E293	.35	6FE6	.35
2E294	.35	6FE7	1.00
2E295	.35	6FF5	1.00
2E296	.35	6FF6	.35
2E297	.35	6FF7	1.00
2E298	.35	6FG5	1.00
2E299	.35	6FG6	.35
2E300	.35	6FG7	1.00
2E301	.35	6FH6	.35
2E302	.35	6FH7	1.00
2E303	.35	6FJ5	1.00
2E304	.35	6FJ6	.35
2E305	.35	6FJ7	1.00
2E306	.35	6FK5	1.00
2E307	.35	6FK6	.35
2E308	.35	6FK7	1.00
2E309	.35	6FL5	1.00
2E310	.35	6FL6	.35
2E311	.35	6FL7	1.00
2E312	.35	6FM5	1.00
2E313	.35	6FM6	.35
2E314	.35	6FM7	1.00
2E315	.35	6FN5	1.00
2E316	.35	6FN6	.35
2E317	.35	6FN7	1.00
2E318	.35	6FQ5	1.00
2E319	.35	6FQ6	.35
2E320	.35	6FQ7	1.00
2E321	.35	6FR5	1.00
2E322	.35	6FR6	.35
2E323	.35	6FR7	1.00
2E324	.35	6FS5	1.00
2E325	.35	6FS6	.35
2E326	.35	6FS7	1.00
2E327	.35	6FT5	1.00
2E328	.35	6FT6	.35
2E329	.35	6FT7	1.00
2E330	.35	6FU5	1.00
2E331	.35	6FU6	.35
2E332	.35	6FU7	1.00
2E333	.35	6FV5	1.00
2E334	.35	6FV6	.35
2E335	.35	6FV7	1.00
2E336	.35	6FW5	1.00
2E337	.35	6FW6	.35
2E338	.35	6FW7	1.00
2E339	.35	6FX5	1.00
2E340	.35	6FX6	.35
2E341	.35	6FX7	1.00
2E342	.35	6FY5	1.00
2E343	.35	6FY6	.35
2E344	.35	6FY7	1.00
2E345	.35	6G4	1.00
2E346	.35	6G5	1.00
2E347	.35	6G6	.35
2E348	.35	6G7	.35
2E349	.35	6G8	.35
2E350	.35	6GA6	.35
2E351	.35	6GA7	1.00
2E352	.35	6GB6	.35
2E353	.35	6GB7	1.00
2E354	.35	6GC6	.35
2E355	.35	6GC7	1.00
2E356	.35	6GD5	1.00
2E357	.35	6GD6	.35
2E358	.35	6GD7	1.00
2E359	.35	6GE5	1.00
2E360	.35	6GE6	.35
2E361	.35	6GE7	1.00
2E362	.35	6GF5	1.00
2E363	.35	6GF6	.35
2E364	.35	6GF7	1.00
2E365	.35	6GG5	1.00
2E366	.35	6GG6	.35
2E367	.35	6GG7	1.00
2E368	.35	6GH6	.35
2E369	.35	6GH7	1.00
2E370	.35	6GJ5	1.00
2E371	.35	6GJ6	.35
2E372	.35	6GJ7	1.00
2E373	.35	6GK5	1.00
2E374	.35	6GK6	.35
2E375	.35	6GK7	1.00
2E376	.35	6GL5	1.00
2E377	.35	6GL6	.35
2E378	.35	6GL7	1.00
2E379	.35	6GM5	1.00
2E380	.35	6GM6	.35
2E381	.35	6GM7	1.00
2E382	.35	6GN5	1.00
2E383	.35	6GN6	.35
2E384	.35	6GN7	1.00
2E385	.35	6GQ5	1.00
2E386	.35	6GQ6	.35
2E387	.35	6GQ7	1.00
2E388	.35	6GR5	1.00
2E389	.35	6GR6	.35
2E390	.35	6GR7	1.00
2E391	.35	6GS5	1.00
2E392	.35	6GS6	.35
2E393	.35	6GS7	1.00
2E394	.35	6GT5	1.00
2E395	.35	6GT6	.35
2E396	.35	6GT7	1.00
2E397	.35	6GU5	1.00
2E398	.35	6GU6	.35
2E399	.35	6GU7	1.00
2E400	.35	6GV5	1.00
2E401	.35	6GV6	.35
2E402	.35	6GV7	1.00
2E403	.35	6GW5	1.00
2E404	.35	6GW6	.35
2E405	.35	6GW7	1.00
2E406	.35	6GX5	1.00
2E407	.35	6GX6	.35
2E408	.35	6GX7	1.00
2E409	.35	6GY5	1.00
2E410	.35	6GY6	.35
2E411	.35	6GY7	1.00
2E412	.35	6H4	1.00
2E413	.35	6H5	1.00
2E414	.35	6H6	.35
2E415	.35	6H7	.35
2E416	.35	6H8	.35
2E417	.35	6HA6	.35
2E418	.35	6HA7	1.00
2E419	.35	6HB6	.35
2E420	.35	6HB7	1.00
2E421	.35	6HC6	.35
2E422	.35	6HC7	1.00
2E423	.35	6HD5	1.00
2E424	.35	6HD6	.35
2E425	.35	6HD7	1.00
2E426	.35	6HE5	1.00
2E427	.35	6HE6	.35
2E428	.35	6HE7	1.00
2E429	.35	6HF5	1.00
2E430	.35	6HF6	.35
2E431	.35	6HF7	1.00
2E432	.35	6HG5	1.00
2E433	.35	6HG6	.35
2E434	.35	6HG7	1.00
2E435	.35	6HH6	.35
2E436	.35	6HH7	1.00
2E437	.35	6HJ5	1.00
2E438	.35	6HJ6	.35
2E439	.35	6HJ7	1.00
2E440	.35	6HK5	1.00
2E441	.35	6HK6	.35
2E442	.35	6HK7	1.00
2E443	.35	6HL5	1.00
2E444	.35	6HL6	.35
2E445	.35	6HL7	1.00
2E446	.35	6HM5	1.00
2E447	.35	6HM6	.35
2E448	.35	6HM7	1.00
2E449	.35	6HN5	1.00
2E450	.35	6HN6	.35
2E451	.35	6HN7	1.00
2E452	.35	6HQ5	1.00
2E453	.35	6HQ6	.35
2E454	.35	6HQ7	1.00
2E455	.35	6HR5	1.00
2E456	.35	6HR6	.35
2E457	.35	6HR7	1.00
2E458	.35	6HS5	1.00
2E459	.35	6HS6	.35
2E460	.35	6HS7	1.00
2E461	.35	6HT5	1.00
2E462	.35	6HT6	.35
2E463	.35	6HT7	1.00
2E464	.35	6HU5	1.00
2E465	.35	6HU6	.35
2E466	.35	6HU7	1.00
2E467	.35	6HV5	1.00
2E468	.35	6HV6	.35
2E469	.35	6HV7	1.00
2E470	.35	6HW5	1.00
2E471	.35	6HW6	.35
2E472	.35	6HW7	1.00
2E473	.35	6HX5	1.00
2E474	.35	6HX6	.35
2E475	.35	6HX7	1.00
2E476	.35	6HY5	1.00
2E477	.35	6HY6	.35
2E478	.35	6HY7	1.00
2E479	.35	6J4	1.00
2E480	.35	6J5	1.00
2E481	.35	6J6	.35
2E482	.35	6J7	.35
2E483	.35	6J8	.35
2E484	.35	6JA6	.35
2E485	.35	6JA7	1.00
2E486	.35	6JB6	.35
2E487	.35	6JB7	1.00
2E488	.35	6JC6	.35
2E489	.35	6JC7	1.00
2E490	.35	6JD5	1.00
2E491	.35	6JD6	.35
2E492	.35	6JD7	1.00
2E493	.35	6JE5	1.00
2E494	.35	6JE6	.35
2E495	.35	6JE7	1.00
2E496	.35	6JF5	1.00
2E497	.35	6JF6	.35
2E498	.35	6JF7	1.00
2E499	.35	6JG5	1.00
2E500	.35	6JG6	.35
2E501	.35	6JG7	1.00
2E502	.35	6JH6	.35
2E503	.35	6JH7	1.00
2E504	.35	6JJ5	1.00
2E505	.35	6JJ6	.35
2E506	.35	6JJ7	1.00
2E507	.35	6JK5	1.00
2E508	.35	6JK6	.35
2E509	.35	6JK7	1.00
2E510	.35	6JL5	1.00
2E511	.35	6JL6	.35
2E512	.35	6JL7	1.00
2E513	.35	6JM5	1.00
2E514	.35	6JM6	.35
2E515	.35	6JM7	1.00
2E516	.35	6JN5	1.00
2E517	.35	6JN6	.35
2E518	.35	6JN7	1.00
2E519	.35	6JQ5	1.00
2E520	.35	6JQ6	.35
2E521	.35	6JQ7	1.00
2E522	.35	6JR5	1.00
2E523	.35	6JR6	.35
2E524	.35	6JR7	1.00
2E525	.35	6JS5	1.00
2E526	.35	6JS6	.35
2E527	.35	6JS7	1.00
2E528	.35	6JT5	1.00
2E529	.35	6JT6	.35
2E530	.35	6JT7	1.00
2E531	.35	6JU5	1.00
2E532	.35	6JU6	.35
2E533	.35	6JU7	1.00
2E534	.35	6JV5	1.00
2E535	.35	6JV6	.35
2E536	.35	6JV7	1.00
2E537	.35	6JW5	1.00
2E538	.35	6JW6	.35
2E539	.35	6JW7	1.00
2E540	.35	6JX5	1.00
2E541	.35	6JX6	.35
2E542	.35	6JX7	1.00
2E543	.35	6JY5	1.00
2E544	.35	6JY6	.35
2E545	.35	6JY7	1.00
2E546	.35	6K4	1.00
2E547	.35	6K5	1.00
2E548	.35	6K6	.35
2E549	.35	6K7	.35
2E550	.35	6K8	.35
2E551	.35	6KA6	.35
2E552	.35	6KA7	1.00
2E553	.35	6KB6	.35
2E554	.35	6KB7	1.00
2E555	.35	6KC6	.35
2E556	.35	6KC7	1.00
2E557	.35	6KD5	1.00
2E558	.35	6KD6	.35
2E559	.35	6KD7	1.00
2E560	.35	6KE5	1.00
2E561	.35	6KE6	.35
2E562	.35	6KE7	1.00
2E563	.35	6KF5	1.00
2E564	.35	6KF6	.35
2E565	.35	6KF7	1.00
2E566	.35	6KG5	1.00
2E567	.35	6KG6	.35
2E568	.35	6KG7	1.00
2E569	.35	6KH6	.35
2E570	.35	6KH7	1.00
2E571	.35	6KJ5	1.00
2E572	.35	6KJ6	.35
2E573	.35	6KJ7	1.00
2E574	.35	6KK5	1.00
2E575	.35	6KK6	.35
2E576	.35	6KK7	1.00
2E577	.35	6KL5	1.00
2E578	.35	6KL6	.35
2E579	.35	6KL7	1.00
2E580	.35	6KM5	1.00
2E581	.35	6KM6	.35
2E582	.35	6KM7	1.00
2E583	.35	6KN5	1.00
2E584	.35	6KN6	.35
2E585	.35	6KN7	1.00
2E586	.35	6KQ5	1.00
2E587	.35	6KQ6	.35
2E588	.35	6KQ7	1.00
2E589	.35	6KR5	1.00
2E590	.35	6KR6	.35
2E591	.35	6KR7	1.00
2E592	.35	6KS5	1.00
2E593	.35	6KS6	.35
2E594	.35	6KS7	1.00
2E595	.35	6KT5	1.00
2E596	.35	6KT6	.35
2E597	.35	6KT7	1.00
2E598	.35	6KU5	1.00
2E599	.35	6KU6	.35
2E600	.35	6KU7	1.00
2E601	.35	6KV5	1.00
2E602	.35	6KV6	.35
2E603	.35	6KV7	1.00
2E604	.35	6KW5	1.00
2E605	.35	6KW6	.35
2E606	.35	6KW7	1.00
2E607	.35	6KX5	1.00
2E608	.35	6KX6	.35
2E609	.35	6KX7	1.00
2E610	.35	6KY5	1.00
2E611	.35	6KY6	.35
2E612	.35	6KY7	1.00
2E613	.35	6L4	1.00
2E614	.35	6L5	1.00
2E615	.35	6L6	.35
2E616	.35	6L7	.35
2E617	.35	6L8	.35

NOW Sensational NEW LOW PRICE on Guaranteed Quality Tubes

1A5GT	3Q4	6AU6	6J5	6SL7	12AU7	12SL7	35W4	53
1A7	3Q5	6BA6	6J6	6SN7	12AX7	12SN7	35Z5	58
1H5	3S4	6BA7	6J7GT	6SQ7	12BA6	12SQ7	38	70L7
1L4	3V4	6BE6	6K5GT	6SU7	12BA7	1978	41	75
1N5	5U4	6BF6	6K6GT	6T8	12BE6	25L6	42	76
1P5	5Y3	6BG6	6K7GT	6V6	12F5	25Z6	43	77
1Q5	6A7	6BH6	6P5	6W4	12J7	26	45	78
1R5	6ABGT	6BJ6	6Q7	6X4	12K7	27	45Z5	80
1S5	6AC5	6C4	6S8	6X5	12S8	32L7	46	82
1T4	6AG5	6C6	6SA7	12AB	12SA7GT	33	47	84
1T5	6AK5	6D6	6SD7	12AL5	12SF5	35B5	50B5	85
1U4	6AL5	6F5GT	6SF5	12AT6	12SJ7	35C5	50C5	117Z3
1U5	6AQ5	6F6GT	6SJ7	12AT7	12SK7	35L6	50L6	117Z6
2A5	6AT6	6H6GT	6SK7	12AU6				

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RADIO COIN MATIC

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high-voltage rectifier is *(a) positive with respect to ground (b) negative with respect to ground (c) has no polarity with respect to ground.*

14. R_5 is the *(a) focus control (b) centering control (c) intensity control (d) gain control.*

15. R_7 is the *(a) vertical centering (b) horizontal gain (c) focus (d) intensity.*

16. Condenser C_2 is used for *(a) synchronizing (b) centering (c) blanking.*

17. R_8 is the *(a) vertical centering control (b) focus control (c) brightness control (d) attenuator.*

18. The 3BP1 cathode-ray tube has a *(a) white trace (b) blue trace (c) green trace.*

19. Tube V_1 is a *(a) vacuum rectifier (b) pliotron (c) thyratron.*

20. The screen diameter of the cathode-ray tube is *(a) three inches (b) five inches (c) four inches (d) seven inches.* —30—

INFRARED LAMP

By DOMENIC R. RIPANI

AN INFRARED lamp is a handy tool to have around the shop for baking moisture out of coils, or "bringing out" those puzzling intermittents due to heat.

A lamp of the 250-watt variety equipped with a standard base may be obtained at any electrical supply house for a little more than a dollar. Used with a small extension over the bench, the lamp may be adjusted in height above the set "being cooked."

A few minutes of baking will invariably put new life into those i.f.'s that have been absorbing moisture for a long time. Intermittents caused by expansion due to rising temperature will become very apparent under this treatment. —30—

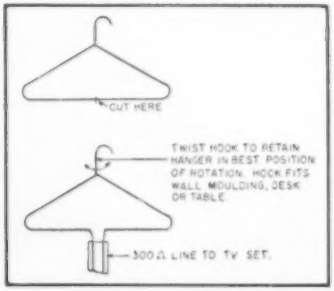
NOVEL TV ANTENNA

By DONALD PALLATZ

AN ORDINARY wire type coat hanger (Fig. 1) makes a dandy TV aerial. Simply cut the bottom section in half and connect paired lead to each end. The hook is used to hang on moulding, desk or table. It may be bent so that hanger is at its best position of rotation.

It was thought at first that this antenna would favor the higher frequency channels, however reception will be found to be good over the entire range. This aerial will not operate where other types of indoor antennas fail. —30—

Fig. 1.


CUT HERE
TWIST HOOK TO RETAIN HANGER IN BEST POSITION OF ROTATION. HOOK FITS WALL MOULDING, DESK OR TABLE.
300 Ω LINE TO TV SET.

Spot Radio News

(*Continued from page 18*)

cerned." *RCA* felt that the demonstrations should be postponed for at least sixty days to provide a reasonable opportunity for field testing its system ". . . to a point when the comparative demonstration would be meaningful."

AS USUAL *CBS* did not agree with *RCA* and in a blunt rebuttal said: "The *RCA* petition on its face, and the actual facts and circumstances surrounding the petition, require the conclusions that the reasons assigned for postponement of the comparative demonstration are specious, and that the actual reasons for its desire for delay lie elsewhere. . . . *Columbia* suggests that any one of the following may well be true, though unstated, basis for *RCA*'s petition: Either *RCA* now realizes the inadequacy of its proposed system and hopes that somehow and in some way before January, 1950, its experts and technicians will come upon something which will rescue *RCA* from its present embarrassed position, or *RCA* now realizes that a comparative demonstration of its color television with the *CBS* system will show, even more clearly than . . . the separate demonstrations, the markedly inferior performance of the *RCA* system, and hence *RCA* wishes to put off as long as possible the day of direct comparison."

RCA wasn't too meek in its reply to *CBS*, stating that ". . . The arguments set forth in the *CBS* opposition consist of no more than efforts on the part of *CBS* to obtain a premature decision, based on inadequate facts, in favor of its system. It completely ignores the fact that the public interest can be served only by a sound decision and not necessarily by a quick decision."

When the smoke cleared, the Commissioners began to ponder, aware perhaps that they were all riding on an infuriated lion and a tactful move was necessary. Thus came about another decision, that two comparative tests would be held, one which we mentioned was being held as this column was being typed and the second during the new year.

A comprehensive two-day program was authorized for the first test, with program material on the air from nine in the morning until nearly three in the afternoon and viewing in three rooms with nine types of receivers: *DuMont* 12-inch black and white, *CBS* converter (10 inch) and 10-inch table model, and *RCA* black and white of the 12-inch or smaller variety; *RCA* color model with a 10-inch screen, *CBS* color with a 12-inch viewer and a *DuMont* 12-inch black and white; *RCA* and *CBS* 16-inch or less color receivers and *DuMont* 16-inch or less black and white. Direct and coax and radio relay circuits were scheduled, with direct programs consisting of wrestling or boxing, choirs or chorus, slides, paint-

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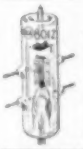

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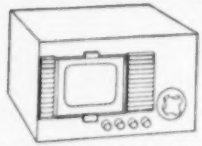

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ings, films, short plays and a women's program including a session in a cooking class, fashion setups, etc. Interview type programs were scheduled for some of the coax tests and a variety show for the radio relay, which was to be routed from Baltimore on a 4 megacycle circuit. Even a commercial potentiality type of program was arranged with toweling, canned goods, breakfast foods, such as bananas and strawberries and cream, and cigarette packages set up for screening. Lighting was also to be studied, particularly during the women's colorcasts, with light to be reduced to approximately ten footcandles during one portion of the transmission.

The *DuMont* contingent was not too keen about the first set of demonstrations, but did feel that the new-year tests might be productive. *DuMont* indicated that *Color Television, Inc.*, of San Francisco would not be able to participate in the current tests and *RCA* and *CBS* were handicapped by equipment problems. These experts felt that the tests would not produce any conclusive information, and would in the main duplicate the unconvincing tests of '47 which proved that color was still a test-tube project. Dr. Goldsmith stressed that before any color could be practical a single tube would be required. He then referred to the experimental work being conducted on one such type of tube, a trichromoscope, based on the designs of Professor Arthur B. Bronwell of the Northwestern University Technological Institute, who described the basic concepts during a National Electronics Conference at the Edgewater Beach Hotel in Chicago, two years ago. At that time Professor Bronwell called his system a composite viewing tube with a single electron gun. Describing its design, he said: "By coating three screens with a different color phosphor which corresponds with the three primary colors, we have a composite image screen which enables the viewer to see the programs in natural color. The three screens are optically superimposed upon each other but are separated by a microscopic distance and electrically insulated from each other."

By controlling the voltage on the screens automatically, each screen may be made to fluoresce in red, blue, and green color sequence, the Professor reported.

Philco also objected to the tests and presented a five-point program which they believed would permit orderly development that "will protect the public." *Philco's* approach to the problem, presented by David B. Smith, vice-president in charge of research and development, stated that: "The standards must be such as to permit the public individually, and at their personal option, to be able to have either black and white or color reception with no loss of program service either way. . . . Both color and black and white must be transmitted on a single set of standards so that each type of signal can be received interchangeably on either black and white or color receiver. . . . The standards must provide a quality of service at least as good as that now provided by the present commercial standards. . . . The continuity

LENSLESS LENS DEVELOPED FOR TELEVISION

A REVOLUTIONARY new lens has recently made its television debut in this country. It is a lens without any lenses—a unique telephoto unit designed by Dr. Frank G. Back, creator of the Zoomar lens, to bring sharp, ultra-ultra close-ups of sports and news events to the nation's home television screens. With this unit on a camera every televiewer has a "better than front row seat."

In the new "Video-Reflectar," as Dr. Back calls his new 40-inch lensless lens, the optical trick is accomplished with mirrors. There is not a lens element in the entire system. Four special reflectors bounce the light beams back and forth to obtain magnification that is said to be so high that the figure of a man more than a block away from a TV camera completely fills the screen of a video receiver.

Up until now, extra long-focus telephoto lenses were out of the question as far as TV pickups were concerned. A lens with a focal length of 25 inches (which by old standards meant that it had to be at least 25 inches long) were about the longest that could be used. Longer focal-length lenses, because of their multiple lens elements, were too heavy and too long, which meant that they were not only shaky but projected into the fields of other lenses used on a camera's turret and their resolution, and thus their picture clarity and quality, was poor.

The new unit is said to overcome all of these objections. It is only 16 inches long in spite of its 40-inch local length. It weighs only 6 pounds, no more than many other TV lenses. It can be mounted directly on a TV camera turret with other lenses without interfering with their operation, and its light weight creates no problems of shakiness nor the need of additional lens or tripod supports.

The new long-focus lens consists of a correction plate (which in position corresponds to the front element on a conventional lens), an aspherical reflector (a mirror shaped like a segment of a large sphere), and three aluminized flat mirrors. The light enters the lens through the correction plate, is picked up by the aspherical reflector, and is then zig-zagged back and forth by the three flat reflectors to the target of the camera's image orthicon.

Lens control (f stop opening) is obtained, not through the use of a conventional iris, but by the adjustment of the position of a rotatable "damper" (similar to the simple damper used in a chimney flue) which is placed directly in front of the aspherical reflector. Depending on the damper's position, it cuts off or supplies more light to provide f stops ranging from f/8 to f/22.

Viewers watching CBS's telecast of the Columbia-Brown football game on November 19th were the first to see the new lensless lens in commercial operation.

—30—

of existing service to receivers in the hands of the public must be maintained. Any proposal of non-compatible standards must include a detailed program to accomplish this purpose. . . . In arriving at these standards there shall be no experimenting at the expense of the public and the Commission will require assurance for the public that the system has been thoroughly proven before authorization of commercial service."

THE STRONGEST BLAST against color TV came from *Zenith Radio's* vice-president, H. C. Bonfig, who before a meeting of Kansas City's Co-op Club declared that there was today no color system with which ". . . both the public and the industry could live."

Commenting on the mechanical systems of reproduction, Bonfig said: "Black and white television started more than twenty years ago with revolving discs, but got precisely nowhere until an all-electronic system was found. . . . I do not believe that we are going to take a step backward to the revolving mechanical discs of yesteryear. . . . This business of revolving color discs is much older than television . . . it is a route that was followed by the motion picture industry many years ago. As early as 1920, and probably before that, there was a projection device developed for producing colored pictures on the screen by means of such color discs. This device was called, I believe, a kinemenascope, and had its origin in England. But it was abandoned, just as mechanical discs were abandoned by black and white TV."

The father of the triode, Dr. Lee deForest, now research director for *American Television, Inc.*, testifying on the stand in Washington, also criticized non-compatible mechanical systems, even including the one he had developed. And thus the debates continued, with apparently most agreeing that a compatible system is the basic need and that perhaps in the new year such a system may be generally approved and adopted, temporarily or otherwise, as a pattern for color TV of the future. In any event, the controversy rages on and on.....L.W.

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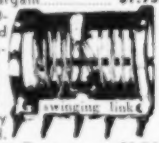

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International Short-Wave

(*Continued from page 118*)

that *Radio Kashmir*, Srinigar, operates on 4.860 at 2130-2330 and at 0700-1230, 0100-0230 on 7.270; radiated power 1 kw.

Kenya Colony—Nairobi, 4.855, has been putting in a nice signal lately in England around 1200; on Thursday 1130-1230 carries BBC's "Variety Bandbox"; BBC news relay daily 1300. (Patrick) Forces Broadcasting Service, Mombasa, is presumed to be the station heard around 1100 on 7.220; this one for some time was on 7.200 although it then announced as operating on 7.220. (Bluman, Israel, via Radio Australia)

Korea—HLKA, 7.933, Seoul, heard in Britain again from 1600. (Pearce) Heard from 0300 by Balbi, Calif.

Luxembourg—Radio Luxembourg, 6.090, noted in England 1330 with dance music. (Staples)

Madagascar—FIQA, 6.06, Tananarive, heard in Sweden to 1500 sign-off. (NATTUGGLAN)

Malta—Forces Broadcasting Service, Middle East, 4.782, is good to fair here in West Virginia from opening 2330; mostly music; announces rarely; takes some BBC relays. Patrick, England, says this station has been putting in a good signal on 6.139, also heard on 4.782 to closing 1700. Heard regularly by Pearce, England, on 4.782 from 1230 to 1700 sign-off when says will return 0430 GMT (2330 EST); BBC news relay daily 1300. Gillett, South Australia, hears the 7.270 outlet to after 1630.

Malaya—The British Far Eastern Broadcasting Service, Singapore, has replaced 6.77 with 6.045 at 0415-1130 to Sumatra, Java, Dutch East Indies Archipelago. Schedule of BFEBS includes also 11.88, 15.30, at 0415-1130, 9.690 at 0630-1130.

Radio Malaya, 9.712, Singapore, noted 0530, news. (Sanderson, Australia)

Mauritius—A Swedish DX-er in receiving verification from V3USE, Forest Side, learned that the station soon would move to the 19-m. band with a schedule of 0930-1130. (Radio Sweden) An airletter just in from Gillett, South Australia, says he hears Mauritius on 7.340 concluding program in French 1230 and then signing off with "God Save the King."

Monaco—Radio Monte Carlo, 9.785, 6.035, on Sundays 1600-1700 has musical program with both French and *English* announcements; widely reported on 9.785 channel. Cox, Dela., says gives QRA of Monte Carlo Calling, Radio Monte Carlo, Principality of Monaco; continues in French news to 1715 or 1720 sign-off. Bellington, N.Y., says on some days is good on both outlets at 1700.

Mozambique—CR7BU, 4.91, noted 1545 with request sessions of music, then news. (Sanderson, Australia)

New Zealand—Sanderson, Australia, reports a good, strong signal from the *new* outlet of *Radio New Zealand*, ZL7, 6.080, at 0530 with news, then music.

Nicaragua—YNDG, 7.660, Leon, "Radio Colonial," sent QSL card and letter; said from January 1, power would be increased to 1 kw. and would change frequency to 5.995. (Pearce, England) Listed on 7.660 with 400 watts.

Pakistan—Karachi, 11.885, is still fair to good with news 0700 and 2100; Dacca, 15.335, occasionally is readable 0700 when is parallel with Karachi.

Paraguay—ZPA-5, 11.945, Encarnacion, heard with music 1815; verified with interesting QSL card; QRA given ZPA5, Radio Encarnacion, Rea Paraguaya de Radiodifusion, Encarnacion, Paráguay. (Mesquita e Sousa, Portugal)

Philippines—DYH2, 6.14, Cebu, heard in Australia 0830 with request session of music, news. (Sanderson) Some days DZH2, 9.64, Manila, is a good signal in West Virginia around 0630-0730 with sponsored programs. Announces, "This is NBC, Manila Broadcasting Station, Voice of the Philippines."

Poland—Radio Polskie, 6.215, Warsaw, now has *English* 1415-1500. (Radio Sweden) Heard in England on 9.530 at 0205-0230 with announcements in Polish, French. *English;* broadcast repeated 0604-0630. (Pearce, England) May be testing? Has been heard in Alabama by Hagen at 0000-0315.

Reunion—Radio Saint-Denis is using 7.170 and 4.800 with 200 watts, 2200-2230, 0300-0400, 0830-0930. QRA is Service Radioelectrique, Saint-Denis de la Reunion, Ile de la Reunion. (NATTUGGLAN, Sweden) Verified reception for Gillett, South Australia, and gave schedule of *only* 0830-0930; 7.170 is fair in Australia, but 4.800 had not been heard as yet; program in French concludes with "La Marseillaise" 0930.

Saint Thomas—The 1949 Edition of "*World Radio Handbook*" says that this small island has started programs in Portuguese over CR5SA, 11.785, and CR5ST, 9.615, with output of 1 kw. each; no schedules given; QRA is Radio Clube de S. Tome e Principe, S. Tome (Saint Thomas) Island. (Radio Sweden) Saint Thomas is a volcanic island and Portuguese Colony of 259 sq. miles; capital is Sao Thome. The islands of San Tome and Principe (joint population 48,809 according to the 1938 census), about 125 miles off the west coast of Africa in the Gulf of Guinea, form a province under a Governor. The islands have an area of 597 sq. miles; chief products are cacao, coffee, rubber, cinchona. (*Has anyone heard either of these outlets?*—KRB.)

South Africa—Winter schedules of SABC received via airmail list Johannesburg, 3.450, not operating; 4.895, 2345-0130 (weekdays), 0055-0130 (Sunday), 1200-1605 (weekdays and Sunday), 1200-1645 (Sat.); 6.007, not operating; 9.523, 0315-0710 (weekdays),

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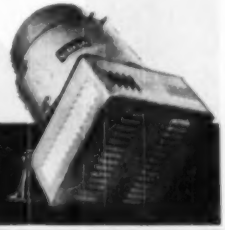

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Southern Rhodesia—Bluman, Israel, lists ZEA, 6.000, Salisbury, 350 watts, at 0300-0330.

Spain—Madrid, 9.369V, now has *English news* 1515, 1800. (Fargo, Ga.)

Spanish Morocco—Radio Tetuan, 6.067, 1.5 kw., operates weekdays 0230-0330, 0830-1000, 1300-1800; Sundays 0830-1000, 1430-1800. (Radio Sweden)

Syria—Bluman, Israel, lists Damascus on 6.000, 500 watts, at 0000-0100, 0530-0800, 1000-1600; 11.750 (moved from 12.000) is in parallel; the 41-m. outlet has been off the air but was to return soon; previously operated in 41-m. band on 7.250.

Tahiti—Papeete, 12.080, scheduled daily 2315-2400, is now using some *English*, in addition to French; seems to be trying to attract tourists to Tahiti. (Bellington, N.Y.) When using *English* gave QRA of P.O. Box 478, Papeete, Tahiti. Music comes through better than voice. (Dallemier, N.Y., others)

Tangier—Radio International, 6.110, opens weekdays 1200 with commercial for *Coca-Cola* (in Arabic). (Bluman, Israel, via Radio Australia)

Thailand—Bangkok recently was heard back on approximately 9.796 at 0615 with news; normally this is carried on 11.65, 6.01. (Sanderson, Australia) Bangkok verified reception of the 11.65 channel, listed power of 500 watts, schedule 0500-0630. (Fellers, Japan)

Trinidad—Radio Trinidad, 9.625, Port-of-Spain, sends *new* schedule of weekdays 0500-0800, 0930-1300, 1500-2200, Sunday 0500-1300, 1500-2300. (McPheeters, N.Y., others)

Turkey—The Mailbag Program on Sundays from *Radio Ankara* is now radiated over TAP, 9.465, 1630-1700. TAP still has news daily 1445. (Fargo, Ga.)

Uruguay—CXA-19, 11.835, Montevideo, noted recently 1700 identifying in *English*; then had news in Spanish. (Alcock, Ky.) Verified with a nice, light-yellow card with a cowboy riding a horse; gave schedule on 11.835 as 0600-2200, using 5 kw. (Oskay, N.J.)

USA—It is possible that the "Voice of America" may soon have a special program for SWL's on the air; if this materializes, I will have details as soon as available.

USSR—Winter schedules as copied from transmissions of *Radio Moscow* include these *English* broadcasts—For North America on 15.23, 11.88, 9.72, 9.67, 7.29 for the three daily transmissions—1820-1930, 2000-2100, and 2200-2255; for the first transmission also uses 7.36; for the second adds 7.36, 9.60, and for the last adds 15.41, 11.78. For Britain, 1230-1300, 11.63, 7.32, 6.09, 6.00; 1430-1530, 9.67, 7.34, 6.09, 6.00; 1630-1700, 9.67, 7.34, 6.09; on Monday, Thursday, Saturday only, 1700-1730, concert, 7.34, 6.09, 6.00; 1730-1900, 7.34, 6.09, 6.00; Sunday only, young people's program, 1100-1130, 11.63, 6.09, 6.00. (Feldman, N.Y.)

Vatican—HVJ, 11.74, 9.645, heard in Australia with *English* 1315, good signal. (Gillett)

Venezuela—Caracas, 4.88, now has *English* news daily 1845-1900. (Boice, Conn.)

* * *

Last Minute Tips

Radio Makassar, Indonesia, soon should be using *Brahms' Lullaby* sung by Bing Crosby as its closing tune; on request, Jerry Pierce, Okla., has forwarded that recording to the station.

Boice, Conn., has just received an attractive QSL card from Radio Clube de Mozambique, Lourenco Marques, Mozambique, verifying his report of

Transmitters of the "Voice of America" relay station at Manila, Philippines.

some months ago; stated the 15.24 channel is not carrying any regular schedule and that the broadcasts Boice heard on that channel were special programs beamed to Portugal; 10 kw. used.

At the time this was compiled, Kol-Israel, Tel Aviv, seemed to be radiating irregularly; some days at 1430 on 9.000 was at good level; other days was inaudible. *Overseas Service should be in operation soon.*

Radio Vorarlberg-Innsbruck, 6.005, Austria, is heard in Britain 0030 with early morning music; news in German 0100; on Wednesdays 1700 carries "Bringing Christ to the Nations" (*English*). (Pearce) Bluman, Israel, lists schedule of 2300-0130, 0400-0800, 0900-1700 (*this may be for summer*).

An unidentified station heard 2135 on 6.226 with programs of Indian songs and music is believed to be Kashmir. (Radio Sweden) Trarkhel, Kashmir, "Azad Kashmir Radio," is listed 6.230V, inactive.

Simpson, Australia, believes a station heard on 7.200 to closing 1530 may be OQ2AC, Elizabethville, Belgian Congo; can be heard only from 1515 since GWZ, London, uses this channel earlier to relay "Voice of America" broadcasts. (New Zealand DX Times)

Radio Belgrade, Yugoslavia, is using 9.505 at 2345-1000, and 6.100 at 1100-1730. (Bluman, Israel) Sometimes is readable on 9.505 at 0115 when has *English* news.

Bluman, Israel, airmails me that the Forces Broadcasting Service, Middle East, Malta, is at present using a 7.5 kw. transmitter; schedule on 7.270 is weekdays 0430-1115, Sunday 0230-1115; 4.782 weekdays 2330-0130, Sunday 2330-0215, and daily 1130-1700. During summer it is likely that 4.782 will be replaced by 6.140 or 7.270, and that 7.270 will be replaced by 11.785 during "daylight."

A station heard mornings on approximately 11.914.5 from *before* 0700 to around 0759 sign-off, with oriental-type programs at times, has been identified as a Soviet outlet; do not confuse with Chungking, 11.913, which does *not* sign on now until 0800.

(*Continued on page* 142)

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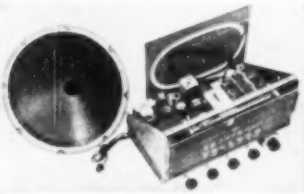

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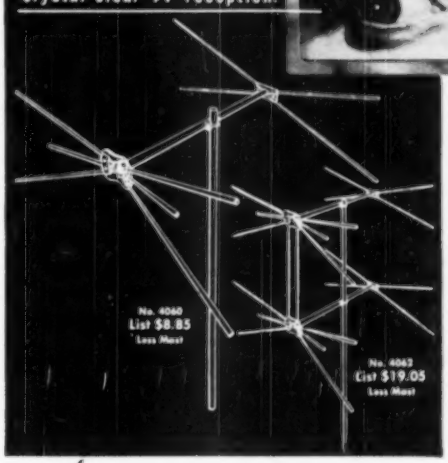

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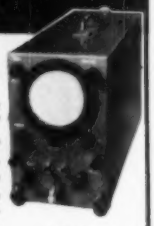

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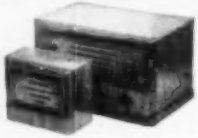

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Bangkok, Thailand, seems to have replaced 11.65 with 9.796 for its 0700-1035 native transmission; 7.105, 6.010 remain parallel. (Dilg, Calif.)

Late flashes from Nordh, Sweden, and Worris, N.Y., confirm definitely that Budapest, Hungary, has increased power to 2 kw. on 6.247 and 9.820 (claimed by station but at times seems high as 9.830); has 15-minute news bulletins at 1200 in Russian, 1300 in French, 1320 in German (for Austria), 1530 in German, and 1830 in *English*; wants reports to Radio Budapest, Budapest, Hungary. Bellington, N.Y., flashes that definitely signs off 1800 with closing announcement in Hungarian, French, German, and *English*.

YDF, Garoet, Java, D.E.I., is back on 2.810; wants reports as was soon to inaugurate a new 500-watt transmitter; wants to use a frequency around 19- to 25-meters, providing it can get permission from authorities. (Radio Sweden)

NATTUGGLAN, Sweden, lists YDK, 4.855, 0.25 kw., *Radio Palembang*, 0530-1000; QRA given as Radio Indonesia, Studio Palembang, Talang Djawa 7, Palembang, Sumatra, Indonesia.

Saigon is anxious to know if it is being heard in the United States at the present time; write to Miss Florence Paverelly, 86, Rue Mac-Mahon, Saigon, Fr. Indo-China. (Butcher, La.) Best chance of hearing this one is on 11.78 at 1800 and/or 0500.

An airmail report from Fellers, Tokyo, says the New China Radio Network (key station is Peiping, 10.260) operates now around 0400-1100 with *English* news 0830-0850 (runs longer irregularly—KRB); frequencies include 10.26, 9.73, 9.01 (moved from 9.04), 7.50, 7.10, and 640 kc. He says that Hankow on approximately 11.47 operates with call BEL-7, a good signal in Tokyo, easily recognized by loud carrier hum; heard irregularly around 0700-1000. *He still has no information as to whereabouts of any Shanghai s.w. outlet. Does anyone have this data?*

At press time a flash was received from Worris, N.Y., that Leopoldville, Belgian Congo, using 9.767, appears to be changing schedules; may use other frequencies now, also. May relay UN programs at times.

A last-minute flash from Dorothy Sanderson, Australia, says that BCAF, Chinese Air Force Station at Taiwan, Formosa, has moved from its noisy 11.68 spot to approximately 8.990; watch for it there mornings. Also that she is hearing a station on approximately 11.740 with news 0700 that she believes is Lahore, Pakistan; seems to be in parallel with Karachi, 11.885, and Dacca, 15.335.

HZM, 4.790, Dhahran, Arabia, usually heard 2330 calling Cairo. (Bluman, Israel, via Radio Australia)

I have just heard the Forces Broadcasting Service, Middle East, 4.782, Malta, at 1600-1700 in addition to from 2330.

According to *Radio Sweden*, Fort-de-

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France, Martinique, has been heard testing on 8.185 and 12.905 at 1730-1800; stated 10.230 would be used another day for test; signal was powerful in England. May be "rumored" *new* 50 kw. transmitter?

SRI, Buenos Aires, Argentina, is sending out an attractive, well-illustrated program-booklet of 60 pages covering the next two months' schedules; has short articles in several languages. Can be had from Servicio Radiofonico International, Calle Belgrano 1841, Buenos, Aires, Argentina.

The Alaskan Command Service noted with WVD on *new* channel of 17.500 at 2130-2200, testing. (Arthur, W. Va.)

The Worldwide Broadcasting Corp. transmits to Europe on WRUW, 11.71, 1515-1600; WRUL, 15.35, 1500-1600, and WRUX, 17.775, 1500-1600; says 11.71 expected to give good reception in Africa and *wants reports from that area.* (Worris, N. Y.)

On the day this was written, I picked up *Radio Pakistan* on the *new* channel of approximately 11.768 at 0700 with *English* news; was in parallel with Dacca, 15.335, which was quite readable; Karachi, 11.885, could not be found although BFEBS, 11.88, Singapore, was in the clear at the time; perhaps Karachi has moved from 11.885 to 11.768, or perhaps the latter is the long-heralded Lahore s.w. outlet? It has been heard 0800 in Texas by Stark, in native; and by Dilg, Calif., at 1015 with *English* news.

Patrick, England, flashes he has received word from Holland that the *Philips* factory at Hilversum is constructing a 100 kw. transmitter for the *Vatican Radio*, expected to be in operation some time this year.

Radio Luxembourg, 6.090, is now unreadable most of the time in Britain due to a powerful Moscow transmitter on this channel. (Patrick)

Patrick, England, says he has lately been hearing a station in England that belongs to the Royal Observatory; call is GMT; carrier frequency is 2.000; located at Leith Hill, N. Dorking; power 250 watts; aerial is inverted L, 70 ft. high, fed by 120 yds. of coaxial feeder; schedule weekdays *only* at 0455-0500 station announcement; 0500-0515 unmodulated on 2 mc.; 0515-0525 modulation at 1000 cycles, and 0525-0530 voice announcement and closedown.

Japanese outlets on 4.910 and 4.930 are good level in California, mornings. (Dilg)

Montevideo, 11.835, Uruguay, heard weekdays at 1900 with religious program. (Bellington, N. Y.)

Sutton, Ohio, reports Lourenco Marques, Mozambique, heard on 9.763 in parallel with approximately 9.720 in native 0130-0200.

Stark, Texas, reports YSW, 5.987, Santa Ana, El Salvador, signs off 2200. He has been hearing TGWB, Guatemala City, Guatemala, on approximately 6.068, evenings. He also had just heard TGWA back on the air but on *new* channel of 9.790 evenings instead of former 9.760. TGWA also re-

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ported heard on 9.790 by Bellington, N. Y., and Ferguson, N. C.; has been heard early as 1800, late as 2330. These Guatemala outlets now announce as "Estacion Commercial de la Voz de Guatemala." Ferguson says he heard *English* announcement around 2330 when said would operate TGWA in 31-m. band evenings, and in 19-m. band mornings; old 19-m. channel was 15.170. *Asks for reports.*

DZH4, 6.000, Manila, noted at 0500 relaying DZMB. Lisbon heard opening 1900 on 6.374. (Stark, Texas)

Bangkok, approximately 9.796, heard the day this was compiled at 0615 with *English* news; left air 0630; bad CWQRM and weak; man read news and definitely announced as "The Overseas Broadcasting Station of Thailand" (no longer says "Siam"). And Saigon, 11.78, was heard from tuning 1810 (signs on 1800 with "La Marseillaise"); French news 1815; at 1845 woman said (in *English*), "This is Radio Saigon," and continued with news in *English*. Good signal but cut to pieces by CWQRM. BFEBS, 11.88, Singapore, Malaya, was in clear 0700, good level, relaying BBC news from London. Chungking, 11.913, opened 0800.

Ulan Bator, 8.397, Outer Mongolia, best in Michigan around 0645-0715; quite good except for sporadic CWQRM. Could not find the parallel outlet on 5.265. (DeMyer, Mich.)

Bellington, N. Y., flashes he had just heard Kol-Yisrael, Tel Aviv, on a *new* channel of 8.80 to 1630 sign-off, strong signal. May have been test.

Budapest, Hungary, frequencies have been measured by Oskay, N. J., as 6.248 and 9.834.6. (Sutton, Ohio)

Acknowledgement

Thanks for all reports received. Keep them coming through the New Year to Ken Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good listening, fellows! . K.R.B.

TRADE SCHOOL GETS LICENSE

WHAT is said to be the first FM station license granted to a privately endowed trade school in the Philadelphia area was recently issued to the Philadelphia Wireless Technical Institute of 1533 Pine Street, Philadelphia.

The license, which is termed a non-commercial educational permit, will allow the school to construct a transmitter capable of covering a 5 mile radius. The institute will program live talent from other schools in the Philadelphia area as well as recorded educational programs.

The station will be operated and managed by students of the radio classes headed by W. W. Zerfing, radio instructor, who is licensed by the FCC to handle the operation of the station. The control room and air-conditioned studio, located in the school building, will have remote control connections to the radar lab, basic radio lab, television lab, refrigeration shops, combustion shops, and the president's office.

The station will broadcast on 90.1 mc. with the call letters WPWT.

—30—

A.F.C. Circuit for TV

(*Continued from page 60*)

The modifications in the waveforms of Fig. 4B as a result of the sine wave superposition are shown in Fig. 4A. It is evident that the angle α is markedly increased over the value shown in Fig. 4B. The phase relationships displayed in Fig. 4A are obtained in a practical circuit by providing L_1 with an adjustable iron core. The amplitude of the sine wave can be set at an optimum value by shunting L_1C_2 with a resistance to fix the circuit "Q" at the proper value.

Circuit Combining A.F.C. and Sine Wave Stabilization

The principles embodied in the circuits of Figs. 1 and 5 are combined in the circuit of Fig. 6, which is essentially what is employed in current-model *RCA Victor* television receivers. This circuit delivers a saw-tooth waveform to the horizontal deflection amplifier through the adjustable capacity divider, C_{1a} and C_{1b}.

Bias for the control tube is obtained from the negative voltage on the oscillator grid through the resistive divider, R_5 and R_6. Rough control of the oscillator period is secured by adjusting the amount of feedback by means of an adjustable powdered iron core common to L_1 and L_2, which are magnetically coupled. Vernier frequency adjustments are made by the front-panel hold control, R_5. This control varies the cut-off potential of the oscillator-control tube, thus altering the nominal average cathode voltage of the tube enough to effect changes in oscillator frequency over a range of approximately 3.5%.

The voltage impressed on the grid of the control tube is a composite of three waveforms obtained from three different sources in the receiver. The stripped sync signal, shown in Fig. 7A, is fed to the tube through C_1. A saw-tooth, shown in Fig. 7C and obtained from across C_{1a}, is also fed to the control tube through an integrating network, R_1 and C_3 plus C_1. This network integrates the saw-tooth to the parabolic form shown in Fig. 7D. To steepen the negative slope of the parabola, a negative pulse, shown in Fig. 7B, is obtained from the horizontal deflection yoke windings and is fed to the control tube through R_4 and C_2. This pulse is attenuated and slightly integrated by R_{1a}, C_3, C_2, and C_4. The resultant waveform impressed on the control-tube grid is a composite of A, B, and D of Fig. 7, and is shown in Fig. 7E. Since the leading edge of the pulse obtained from the deflection yoke forms the negative slope of the composite waveform, initiation of the horizontal retrace coincides with the center of the sync pulse. Sufficient time is thus assured for the completion of the retrace before the end of the blanking pulse.

A trimmer condenser, C_n, is employed to set the amplitude of the control-tube grid waveform at the desired value. Fig. 8 illustrates actual oscilloscope photographs of some of the waveforms in the circuit of Fig. 6.

Acknowledgment

The author wishes to express his sincere appreciation to the inventor of the herein-described circuits, Simeon Tourshou, of the *RCA Victor Division*, for his kind assistance in the preparation of this paper.

—30—

Stratovision

(Continued from page 37)

on some flights and proved to be a valuable source of information. Area covered by reports agreed very well with predicted coverage.

An angle of five degrees or greater is obtained for only the first mile from a 500-foot high antenna compared with 64 miles from the 30,000-foot antenna. An angle of one degree or greater is obtained for only 5 miles from a 500-foot high antenna as compared with 168 miles from the 30,000-foot antenna.

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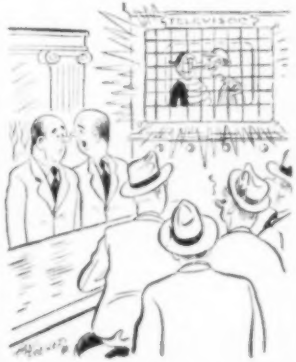

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.05 mfd	600 VDC	.25	.20
.25 mfd	600 VDC	.25	.20
.1 mfd	600 VDC	.25	.20
.25-.1 mfd	600 VDC	.30	.30
.1 mfd	600 VDC	.30	.30
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.1 mfd	500 VDC	.30	.25
.1 mfd	600 VDC	.30	.25
.2 mfd	600 VDC	.35	.30
.4 mfd	600 VDC	.50	.45
.5 mfd	600 VDC	.60	.55
.8 mfd	600 VDC	1.00	.90
1.5 mfd	600 VDC	1.00	1.00
10 mfd	600 VDC	1.10	1.00
4 mfd	750 VDC	.75	.60
.5 mfd	1000 VDC	.45	.40
.2 mfd	1000 VDC	.55	.50
.5 mfd	1000 VDC	1.10	.90
.25 mfd	1000 VDC	1.95	1.60
.1 mfd	1000 VDC	1.60	1.70
1 mfd	2500 VDC	2.60	2.30
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56	.75	6T-12	.80
210	.45	6BV7	2.50
211	.45	6BW7	2.50
500	.50	6CB6	1.10
717A	.55	6DP4	3.50
801A	.45	6DT6	1.00
803	4.25	6HG7	.90
805	8.50	6J4	.95
807	1.75	6J5	.95
807	1.00	6J6	.95
809	.40	6J7	.40
872A	1.45	6K6GT	.40
1616	.60	6L6	1.10
1619	.35	6N7	.50
1629	.25	6SH7	.40
1630	.60	6SJ7	.40
1631	.25	12AN5GT	.50
1632	.50	12SN7GT	.50
9002	.50	25Z5	.50

ROTARY SWITCHES

Pole	Position	Section	Shorting	Price
1	2	6	Yes	$0.35
1	3	6	Yes	.30
1	4	6	Yes	.30
1	6	6	Yes	.35
1	12	6	Yes	.45
1	6	6	No & SWVA	
			FLASH OVER	1.45
2	12	3	3°	.50
2	6	3	3°	.50
2	12	3	3°	.50
2	6	3	3°	.50

2 Pole 2 Circuit 6 Cont. w Knob .33

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6.3 V @ 10 A, 6.3 @ 6 A, 6.3 @ 6 A $3.00
5 V @ 3 A, 6.3 @ 6 A, 6.3 @ 6 A, 6.3 @ 6 A $5.50
6.3 V @ 3 A, 6.3 @ 3 A CT 5 A $3.45

POTENTIOMETERS

WIREWOUND Cat. No.	OHMS	WATT	TAPER	Bushing	Shaft	SPEC'N	EA.	PRICE TEN
035	2000 Dual	2	LINEAR	½"	¼"	TREZ	$0.85	$0.80
0C305	5000	2	LINEAR	½"	¼"	TREZ	75	75
096	7500	3	LINEAR	½"	¼"	TREZ	75	70
0E5B10	25,000	3	LINEAR	½"	¼"	WIRT	80	75
0C8D5	25	25	LINEAR	½"	1½"	DEJUR	45	40
OHMITE	30	25	LINEAR	½"	1½"	OHMITE	45	40
04B81	50	25	LINEAR	½"	1½"	DEJUR	50	40
19D81	100	25	LINEAR	½"	1½"	DEJUR	55	45
16781	250	25	LINEAR	½"	1½"	DEJUR	55	45
07281	500	25	LINEAR	½"	1½"	DEJUR	55	50
033	3000	25	LINEAR	½"	1½"	DEJUR	65	55
01U81	5000	25	LINEAR	½"	1½"	DEJUR	65	60
15581	15,000	25	LINEAR	½"	1½"	DEJUR	70	65
099	20,000	25	LINEAR	½"	1½"	DEJUR	85	70
105	20,000	25	LINEAR	½"	1½"	DEJUR	85	70
03B81	5	50	LINEAR	½"	1½"	DEJUR	1.00	90
065B1	50	50	LINEAR	½"	1½"	A C	1.00	90
OHMITE	800	50	LINEAR	½"	1½"	OHMITE	1.10	95
078	10,000	50	LINEAR	½"	1½"	DEJUR	1.50	1.25
02	15	50	LINEAR	½"	¼"	OHMITE	1.50	1.25
IRC	15	25	LINEAR	½"	¼"	IRC	1.50	1.25
OHMITE	750	150 w SNOB	LINEAR	½"	¼"	OHMITE	2.45	2.10
MILSPOT	20,000	5 0.5%	LINEAR	½"	¼"	GIBBS	4.50	4.00

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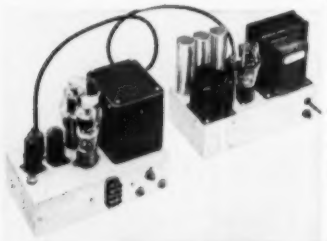

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Intermodulation distortion at 5 Watts less than 0.2%; less than 8% at 12.2 W.
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Tubes: 6SN7 voltage amplifier and cathodyne phase inverter, 6SN7 push-pull driver, 2 - 807's used as triodes in push-pull output stage, 5U4G rectifier.
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MARS Station of the Month

MARS BEAMS WEEKLY BROADCASTS

MARS—Army Headquarters station, WAR, located at the Pentagon Building, Washington, D. C., broadcasts a weekly message each Tuesday at 0100Z and at 0400Z. (This is Monday at 8 p.m. and 11 p.m., Eastern Standard Time; Monday at 7 p.m. and 10 p.m., Central Standard Time; Monday at 6 p.m. and 9 p.m., Mountain Standard Time; and Monday at 5 p.m. and 8 p.m., Pacific Standard Time.)

Simultaneous broadcasts are made on frequencies 6997.5 kc., 14405 kc., and 20994 kc. Each message is sent three times, once at 10 words per minute, once at 15 words per minute, and once at 20 words per minute.

Designed especially to transmit quasi-official traffic and training information to MARS members, the broadcast offers an excellent opportunity to all amateurs in building up their code proficiency.

NOW hear this!

The Military Amateur Radio System afloat now consists of one ship station (A6WAD-K6WAD) and two MARS members, A6GRP-W6GRP and A6WFZ-W6WFZ, aboard the U.S. Army Mine Planter *Ellery W. Niles*.

A Navy terminology which refers to doors as "hatches," floors as "decks," walls as "bulkheads" and latrines as "heads" is not new to these boys. A6GRP is Warrant Officer Louis M. Sieber, U. S. Army Mine Planter Service, and A6WFZ is Sgt. 1/C Leroy G. Hankins. "Hank" (ex-W9ABG) is the ship's radio operator.

The boys do most of their hamming on 40 meters at present. However, they're working on a 10-meter rig and expect to have it on the air right away.

Equipment aboard the *Niles* consists of two *RCA* transmitters and a *Collins* TCS-1. The 8010 is used exclusively for ship's work, the TCS-1 for MARS. Receivers are an *RCA* AR8510 and an SX28.

The *Ellery W. Niles*, assigned to the Coast Artillery for Harbor Defense, is currently assigned to mine work and cable operations in San Francisco Bay and other West Coast ports as needed. Details of her activities are not available because of security reasons. However, the ship will be remembered as the first and only diesel electric Mine Planter in the Army.

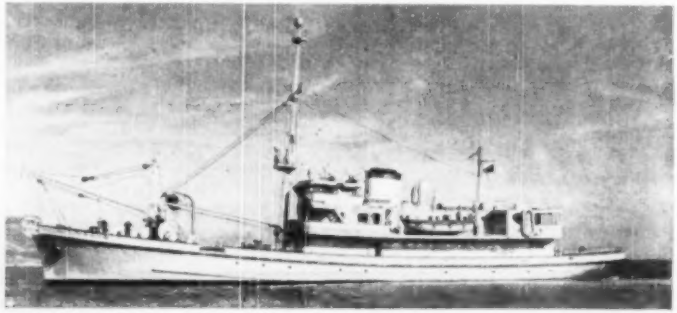
A6GRP copies at the mill while A6WFZ keeps careful eye on the ocean-going transmitter.

Commissioned in 1938, the *Niles* toured all East Coast ports enroute to San Francisco Bay where she was stationed until 1939. She next went to the Pacific side of the Panama Canal where she directed the laying of the Pacific side mine fields to defend the Canal Zone.

The *Niles* was returned to San Francisco in 1940, played a major part in laying mine fields, assisted the Navy in maintaining Navy Loops, and laid cable in San Francisco Bay.

Seamen remember her for her peculiar characteristics when under way. One Coast Artilleryman referred to her as the "ship to end all ships."

The U.S. Army Signal Cableship "Ellery W. Niles" as she looked in 1947.



"Of course I remember her," he said, "she pitched like a blinkin' billygoat."

But the mine planting/cable-laying MARS members laugh away all suggestions that they might be too sick to operate.

"We take great pride," they aver, "in having strong stomachs and even stronger radio signals. You give a shout, we'll QSO and QSL."

—30—

Mac's Service Shop

(Continued from page 44)

high enough to cover such possibilities.

"That way of doing business places a heavy strain on the service technician's ethics. After the customer has indicated that he will hold still for the higher charge, there is always the temptation to let that figure stand, even though the repairs needed do not warrant it. The service technician can always quiet his conscience by telling himself that on the next job matters will probably be reversed and *he* will take the licking. A technician I know argues, 'If you lose on the popcorn, you gotta make it up on the peanuts.' That's no good. There is no such thing as 'averaging up' your honesty. Either you shoot square in every little detail or quit trying to claim you are an honest man."

"Any more reasons why you are so fond of free estimates?"

"Plenty of 'em. The practice encourages slipshod work. If the service technician feels forced to stay inside a hastily-given estimate, he is quite likely to try to patch or cobble up some repairs that were not foreseen or provided for in the price quoted."

"But the practice does bring in business, doesn't it?"

"I have never been convinced that it does—at least not the kind of business you want. It does attract the 'shoppers,' the something-for-nothing individuals, and the characters who believe that all service technicians are automatically cheats and swindlers; but people in general have come to distrust 'free' offers. The word has come to be associated with cheap, come-on tricks in advertising. You yourself know the kind of offers you usually get in second-class envelopes that have the word FREE! plastered all over the outside in big red letters."

"Why is it that every now and then a radio parts manufacturer comes out in favor of free estimates?"

"It is easy to play Santa Claus with someone else's time or money. Can't you just hear the manufacturer scream if we suggested he give away some of his tubes or resistors or condensers? Very, very few of the veteran service technicians with whom I have talked are in favor of free estimates. They say that when doctors start giving free diagnoses, they will start giving free estimates, but not before. They argue that the radio service business has enough headaches in it now without adding those that are a part of free estimating."

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SX-71 RECEIVER

The SX-71 offers superior Ham Band performance in the moderate price range—value packed with features specifically asked for by Hams. Features include Double Conversion sharp selectivity, plus built-in NBFM at moderate cost. 10 tubes plus voltage regulator and rectifier.

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S-40A RECEIVER

Frequency Range 540 KC to 43 MC. Temperature compensated oscillator. One RF, 2 IF, 3 Watt Output. 4 Bands. 8 tubes plus rectifier. Internal speaker. Has AF & RF gain controls, AVC, BFO, and Noise Limiter switches. The finest set on the market at this low price.

$79.95

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Just right for your control room walls. Approximately 28" X 26". Contains time zones, amateur zones, monitoring stations. Mail coupon today and 25c

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A brand new catalog containing the most complete listing of radio and television parts and accessories — everything for the radio man and the amateur radio operator. You'll save money buying from our new catalog.

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☐ List of Used Equipment

Please send me:

☐ Radio Map ☐ SX-71 Info

☐ New Catalog ☐ S-40A Info

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Address .....

City ..... State .....

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PR-30 Receiver For MOBILE CALLS

Emergency thrills . . . hear "news in the making" . . . as it happens.

6 Tube superheterodyne, 115 volts, AC or DC. Now you may enjoy . . .

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- FIRE
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- MARITIME
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$44.95 LIST PRICE

PR-7 POLICALARM tunes 152-162 mc. $39.95

See your dealer or write Dept. RN-1

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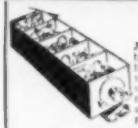
RADIO Surplus Buys



R-1/ARR-1 HOMING RECEIVER

Jan. RADIO NEWS article tells how to convert this receiver to high freq. converter for use with your present receiver. Easily converted, compact, well built. Like new with four acorn tubes and plug. Priced at only **$9.95**

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6½' CONTROL CABLE for above command sets	$ 1.00

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BC-433G COMPASS RECEIVER	$14.95
BC-603 FM RECEIVER	$12.95
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140 to 144 MC Crystal controlled. 10 watt output. 13-tube receiver, containing 2 individual RF sections and A10 MC IF amplifier. Both RF sections may be operated simultaneously or individually. Less crystal, dynamotor and tubes.

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EASY TO ERECT. Universal base fits any pitch or flat roof. Bolt sections together and install in one to two hours

STRONG. Cross braces every two feet, lattice braces between, resist high winds

DURABLE. All aluminum, needs no painting, no maintenance

LOW PRICED. Engineered design uses all material to best advantage. Sales method cuts out middlemen' profit

Order immediately one of two ways:
(1) Remit 20% now, balance C.O.D.
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PRICES: All prices include universal base. All sections completely fabricated, ready to bolt together. All bolts and hardware furnished.

12-ft. Tower	$17 50
24-ft. Tower (Two 12-ft. Sections)	32 50
36-ft. Tower (Three 12-ft. Sections)	47 50
48-ft. Tower (Four 12-ft. Sections)	62 50

10-ft. Mast, if desired, adds 8 feet to Tower height. Price $2.00

$17.50 UP

Factory-to-user plan not only means lower price but avoids pick-up cost and bother. You'll appreciate it.

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"Then you think the birds who give these estimates are dopes?"

"Oh me!" Mac sighed. "I did not say that. That is the trouble with being young: you cannot be sure you are right unless you can prove someone else is wrong! In some cases and in some localities, free estimates may be a good thing. I do not know. All I know is that I do not like them or intend to give them. We charge a flat minimum for making an estimate; but we do a good, thorough, unhurried job of finding everything that is wrong with a set and the cost of putting it right. There is no padding of the estimate to take care of overlooked items, because we have taken the time to make a careful survey of the set. We could afford to take this time because we were being paid for it. The estimate is well worth our customer's money [illegible] it gives him an accurate figure upon which he can depend in deciding whether he should have the set repaired or buy a new one."

"In short," said Barney with his flair for slogans, "all we 'give' our customers is a square deal—but who wants anything more?" —30—

SERVICE HINTS

By R. J. KIEFER

HERE ARE several handy service hints that will save time and money.

To remove filings from PM speakers, remove the cone with coil, wrap a toothpick with a thin layer of absorbent cotton and work it gently around the speaker's center pole piece. Small filings will work into the cotton while the large pieces can be brought out to the front where they can be picked out with tweezers.

Very thin cardboard shims can be used for positioning and gluing the cone on the speaker frame. Make the cardboard several inches long and slip the speaker cone on the end. Then apply speaker cement to the required areas and rapidly push the cone down to the proper place on the frame.

On cabinet scratches where the finish is not broken down to the wood, a slight puncture should be made with a needle underneath the scratch. This allows stain to soak into the wood and will go a long way toward making the scratch inconspicuous. —30—

"Nervous contestants!"

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110 V. 60 Cy. AC
850V CT @ 1V @ 5A @ 6.3V @ 3A @ 5V @ 3A. Conservatively rated @ 148 Mfr. tested @ 250 mill and will handle more. A steal at $2.95

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Printed Circuits

(Continued from page 55)

of any high capacitance between the crossed conductors.

As mentioned in Part 1, small condensers can be painted by using silver-painted areas on opposite sides of the base plate, especially when the plate is of thin, high-dielectric material; but the experimenter will find it much easier and more accurate to use the tiny disc-type ceramic condensers by connecting them to the conducting lines at the points needed.

These condenser leads, as well as tube leads, transformer leads, etc., can be connected to the painted lines by either soldering or painting. When soldering, the painted surface is first sanded clean and a drop of solder placed on it and flattened out; then the tinned conductor is placed on this drop of solder, which is remelted just enough to bond it to the conducting lead.

In order to get the "feel" of drawing printed circuits, it is a good idea to reproduce in miniature some simple electronic device such as the code oscillator shown in connection with the *Microcircuits* kit; but the real field for these printed circuits lies in those pieces of equipment where the reduction in bulk and weight is of actual and not just "curiosity" value. Careful study of the accompanying pictures of transmitters, receivers, and amplifiers will show the reader what has been accomplished along these lines by expert technicians and will provide him with many valuable pointers in regard to layout, printing of inductors, tube-placement, etc.

While standard components *can* be used with printed circuits, there is not much sense in using a log-chain leash on a Pekingese or in employing a tube or transformer that is five or six times as big as all of the rest of the circuit. Subminiature tubes and the other tiny components used in hearing aids make ideal companion units for printed circuits, and practically all of them will be found advertised in the pages of RADIO & TELEVISION NEWS. Table 2 gives subminiature tube characteristics that will be found useful in designing printed circuits.

In conclusion, the writer would like to say that he never could understand what pleasure the head-hunters got out of shrinking the noggins of their enemies to the size of a human fist; but he knows there is a very decided thrill in building equipment in about one-tenth the space normally required.

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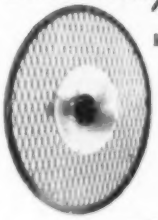
—30—

for superb HIGH-FIDELITY *reproduction*

MASCO *high frequency tweeter unit* HFT-100



HFT-100 with mounting screen

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EXCLUSIVE NEW TWEETER THAT GIVES *living presence*

with NO distortion
NO cumbersome horns
NO crossover network necessary
NO additional space required
NO narrow dispersion angles
NO need for separating sound sources

HFT-100 Specifications

Frequency range	900 to beyond 15,000 cycles
Impedance	5 ohms
Power Handling Capacity	8 watts
Dispersion, horizontal and vertical	70 degrees
Width, less screen	5¼ in.
Height, less screen	5¼ in.
Depth	2⅝ in.

Wide range reproduction from the lowest response of the cone speaker to better than 15,000 cycles is obtained by using the HFT-100 Tweeter.

The tweeter is mounted within the cone speaker and connected in series with it.

No filter network is necessary. The HFT-100 has a built-in mechanical filter.

HFT-100 with attached mounting screen for 12" cone speaker.....**$24.50** List Price
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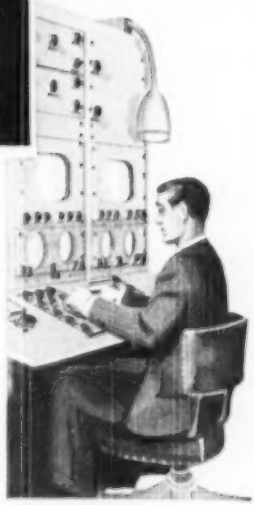

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SOLDERING EQUIPMENT

The complete line of soldering products made by *P. Wall Manufacturing Company* and its new division, *Harmic Manufacturing Company*, is described in the new *Wall* catalogue which is currently available.

Included in the line are gasoline and kerosene blow torches, self-generating alcohol blow torches, electric soldering irons, solder, splicer's furnaces, paraffin supplies, and compound kettles. Also described is the company's line of oilers, grease buckets, shop torches, and steel gongs and shells.

Copies of Catalogue No. 85 may be secured by writing to *P. Wall Manufacturing Company*, 425 Erie Street, Grove City, Pennsylvania.

POWER TOOLS

The extensive *Thor* line of portable power tools is presented in the new catalogue issued recently by *Independent Pneumatic Tool Company* of Aurora, Illinois.

Known as Catalogue E-2, this publication gives complete data including prices on all *Thor* universal electric tools. A special circular (No. JE-1131) covering the new *Thor* Silver Line 4½" universal electric belt sander is also available on request.

Copies of either the catalogue or the circular, or both, may be obtained by writing the company at 175 State Street, Aurora, Illinois.

FREE TV HISTORY

A four-color, illustrated booklet entitled "History and Manufacture of Television Receivers" and written by Frank A. D. Andrea is being made available to the public by *Andrea Radio Corp.* of Long Island City, New York.

In addition to covering the background and development of television, Mr. Andrea gives suggestions on what the television buyer should look for when purchasing a video receiver.

Distribution is being made through *Andrea* dealers. Copies are free of charge for the asking.

RCA'S VESTPOCKET GUIDE

The 1950 edition of the *RCA Tube Department's* "Tube Reference and Calendar Notebook" is now available from the company's tube distributors.

A miniature encyclopedia of practical, everyday radio and television service data, this book has been especially prepared for radio and television service dealers, engineers, technicians, radio amateurs, and purchasing agents. It is a memo book, world atlas, and business diary as well.

Now in its 20th year of publication, the 1950 edition has been brought up-to-date and includes a valuable television service data section and the latest information on tubes and batteries. There are 47 pages of receiving tube characteristics and socket-connection diagrams and 12 pages of technical data on 300 of the company's power, cathode-ray, photo, and special tubes for radio and the industry.

Copies may be obtained from *RCA, RCA Victor*, and *Cunningham* tube distributors.

"THE PERMO REPORTER"

Persons interested in the art of recording and reproduction will welcome the addition of a new publication, "The Permo Reporter" to the literature available on the subject.

Bulletin 1, the first of a series of such leaflets, covers the topic "There is no Permanent Phonograph Needle." Subsequent issues will discuss characteristics of shellac-type and plastic records and their effect on the phonograph needle, needle problems and solutions incident to the introduction of microgroove and 33⅓ and 45 r.p.m. turntable speeds, etc.

Readers may receive this bulletin regularly by sending their name and address to *Permo, Incorporated*, 6415 Ravenswood Avenue, Chicago 26, Illinois. Ask that your name be added to "The Permo Reporter" mailing list.

1950 NEWARK CATALOGUE

The company's 1950 catalogue of radio, television, electronic, and sound equipment is now available, according to *Newark Electric Company, Inc.*

The new publication features kits, sets, parts, and accessories. There is a special section devoted to high fidelity FM and AM radio and phono instruments for custom installation. This equipment is specially grouped in the catalogue.

Newark is also offering a free brochure explaining FM, what it is, and what it does.

Either or both of these publications may be secured by writing to the company at 242 West 55th Street, New York 19, New York.

MINIATURE RECTIFIERS

Federal Telephone and Radio Corporation has released a data sheet covering its line of standard miniature selenium rectifiers and selenium rectifier stacks.

The various units in the line are pictured and complete operating data is provided in tabular form.

This handy and compact reference sheet may be secured by writing the company at 900 Passaic Avenue, East Newark, New Jersey.

BI-METAL THERMOSTATS

A single-sheet bulletin describing the company's Type R bi-metal strip thermostats for use in appliances, industrial apparatus, and electronic equipment has just been released by *Stevens Manufacturing Company, Inc.* of Mansfield, Ohio.

Illustrations include a schematic diagram of the operating principle, typical thermostat response curves, cutaway view of the unit, and a photograph showing various standard designs.

PENN TV TOWERS

Penn Boiler & Burner Mfg. Corp. of Lancaster, Pennsylvania is currently offering a four-page bulletin which covers its line of television towers.

These video receiving antenna towers feature sectional construction and hinged base plates which provide safe and easy mounting of the tower on sloping surfaces. Other construction and installation features are described in the folder. A dealer price list is included.

Copies of this bulletin are available from the company on request.

TRANSFORMER CATALOGUE

A 16-page catalogue which illustrates and describes the company's line of transformers for original equipment, radio and television, replacement, and amateur applications, has just been issued by *Triad Transformer Manufacturing Company* of Los Angeles.

Formerly available only as components in original equipment, the *Triad* line is now being stocked by distributors. The new catalogue is the first to be issued under the new sales program.

Featured in the catalogue are the company's "HS" (hermetically sealed) series transformers.

Copies of this catalogue, known as the TR-49, may be obtained by writing *Triad Transformer Manufacturing Company* at their new address, 2254 Sepulveda Blvd., Los Angeles 64, California.

SELENIUM RECTIFIERS

A new booklet which describes standard and high-voltage rectifiers for use in power supplies and electronic circuits is currently available from *Westinghouse Electric Corporation.*

Efficiency curves for both the standard (type M) and high-voltage (type H cells) are included, together with discussions entitled "Efficiency—Aging—Life," "Back Leakage—Reverse Resistance," and "Forward Resistance." Life characteristics of types H and M cells, for various overload conditions

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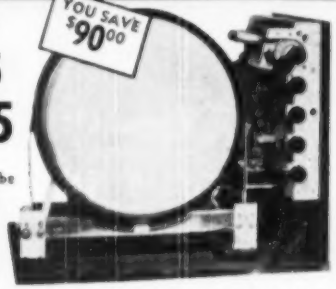

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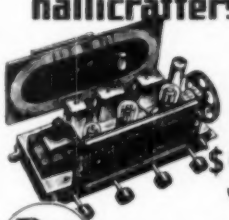

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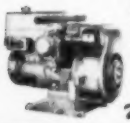

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or high ambient temperatures, are plotted graphically.

The booklet concludes with a tabular presentation of schematic diagrams, formulas for calculating rectifier performance, and cell ratings for a wide range of applications.

For a copy of this booklet, DB 19-025, write *Westinghouse Electric Corporation*, P. O. Box 868, Pittsburgh 30, Pa.

"NEEDLE TIPS"

Jensen Industries, Inc. is currently distributing an interesting sales bulletin "Needle Tips" to jobbers and distributors of the *Jensen* line of phonograph needles.

Written in informal style, the first issue of the bulletin covers such topics as long-playing records, the trend in retail sales of records and accessories, the need for salesmanship, and information about several new needles being introduced by the company.

Copies of "Needle Tips" can be obtained by writing to the company at 329 S. Wood Street, Chicago, Illinois.

TV "PICT-O-GUIDE"

A second volume of *RCA's* Television "Pict-O-Guide" for video technicians has just been announced by the *RCA Tube Department*.

This popular servicing aid contains troubleshooting photographs which enable the technician to locate TV receiver troubles by the "picture analysis" method. The new book is authored by John Meagher, TV service authority of the *RCA Tube Department*, who also prepared the first volume. Volume 2 contains more than twice as many new pictures and a greatly expanded text to supplement the information in the first book.

These two volumes are unique in the television servicing field and are designed to simplify television service by reducing abstract television servicing theory to practical, down-to-earth working information.

The books are in loose-leaf album form and contain unretouched photos taken from the face of a kinescope which show the effects of operating troubles on the television image. By careful study and comparison of the images appearing on the face of faulty receivers and the photographs in the "Pict-O-Guide" the service technician can narrow down the cause of a faulty image to a specific section of the receiver.

Distribution is through regular *RCA* distributor channels.

—30—

ANSWERS TO "SCOPE QUIZ" PAGE 132

1. c	5. a	9. a	13. b	17. a
2. a	6. b	10. d	14. c	18. c
3. d	7. d	11. b	15. c	19. c
4. b	8. b	12. b	16. c	20. a

SCORING TABLE

19-20 correct	excellent
16-18 correct	very good
13-15 correct	good
10-12 correct	fair
9 or less	poor

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Crystal Receiver

(Continued from page 39)

The author's socket (See Figs. 6 and 8) consists of a ring-shaped base shell for clamping the CK-703 shell, and two short lengths of spring wire for pressure contact against the side of each base pin. The wafer is a rectangular piece of thin lucite, but can be made of bakelite or other phenolic. The CK-703 is inserted into the tight-fitting base shell, and its pins pass through small-diameter clearance holes in the wafer to be contacted by the straight wire springs mounted underneath. Small soldering lugs are provided for circuit connections to the three contact members of the socket.

Since the contact pins protrude just below the center line of the CK-703 base (See Fig. 5B), the unit can be plugged into the socket only in the correct position. Thus, all danger is removed of inserting emitter or collector pin into the wrong hole.

The entire audio amplifier is built on a strip of $\frac{1}{16}$-inch-thick bakelite, $4\frac{7}{8}$" long and $1\frac{1}{4}$" wide. Fig. 2 is a view of this amplifier strip. All components are mounted on the strip, except condensers C_6, C_8, and C_9 which are mounted directly under the main chassis (See Fig. 3), and electrolytic condenser C_5 which is "hung" between the battery terminals. The small coupling transformers are held to the strip by means of bands bent from $\frac{3}{16}$-wide brass. These mounting bands must not be used if the transformers are mounted directly in contact with a metal chassis, since they might form eddy current loops). The amplifier strip is supported on the chassis (See Fig. 1) by means of four 1-inch 6-32 screws.

The entire set, as shown in Fig. 1, is built on a 7"x7"x2" metal chassis. The tuning dial plate is home-made. The headphone jack, which must be insulated from the chassis, is mounted along the front lip of the chassis, as is the battery "On-Off" switch.

The author employed a 2-section tuning condenser (with only one section in use), as shown in Fig. 1, simply because a single-section unit was not immediately available. The antenna coil, L_1-L_2, is mounted under the chassis directly below the tuning condenser. This coil is provided with a slip-over primary (L_3) which may be slid off temporarily while a center tap is soldered to the secondary coil (L_2).

Center tapping the coil is a delicate operation, since the coil is wound with rather fine wire. But it can be accomplished easily, provided a reasonable amount of care is used. Locate the center turn and, using a sharp razor blade, carefully scrape about $\frac{1}{4}$ inch of the enamel off the wire. Avoid scraping the adjacent turns. Solder a length of No. 32 insulated wire to this scraped portion, replace the primary, and run the tap lead directly to the 1N54 crystal diode.

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1A4P	1.40	5Y3GT	.45
1A5GT	.65	5Y4G	.54
1A6	1.15	5Z3	.85
1A7GT	.72	6A4	.80
1B3P	1.40	6A5	.96
1B5 25S	1.15	6A6/LA	1.15
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6SF5	.72	6Z7G	1.15
6SF7	.72	6ZY5G	.80
6SG7	.72	7A4	.72
6SH7	.60	7A5	.72
6SJ7	.60	7A6	.72
6SK7GT	.60	7A7	.72
6SL7GT	.65	7A8	.72
6SN7GT	.80	7B4	.72
6SQ7	.60	7B5	.72
6SR7	.65	7B6	.72
6SS7	.96	7C5	.72
6SV7	1.15	7C6	.72
6T7G	1.15	7C7	.72
6U5	.72	7E6	.72
6U8	.65	7F7	.80
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6V6	1.15	7H7	.72
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7Y4	.72	35A5	.72
7Z4	.72	35B5	.72
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12AF	1.15	35Y4	.65
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12AT	1.15	35Z4GT	.54
12AU	.72	35Z5GT	.65
12AH7GT	1.15	36	.96
12AT6	.60	37	.65
12BA6	.65	38	.80
12BE6	.65	39/44	.96
12C8	1.15	41	.60
12H6	.65	42	.60
12SQ7	.54	43	.60
12V7GT	.72	45	.60
12K7GT	.60	45Z5	.65
12K8	.65	45Z5GT	.65
12Q7GT	.65	46	.65
12SA7GT	.65	47	.85
12SC7	.80	48	1.40
12SF5	.65	50	.96
12SF7	.72	50	1.40
12SG7	.72	50A5	.80
12SH7	.80	50B5	.72
12SJ7	.80	50L6GT	.66
12SK7	.80	50X6	.80
12SK7GT	.80	50Y6GT	.65
12SL7GT	.85	56	.96
12SN7GT	.80	56	.65
12SQ7GT	.60	57	.72
12SR7	.80	58	.72
12Z3	.98	75	1.40
14A4	.98	76	.72
14A5	1.60	77	.60
14A7	.88	78	.60
14B6	.88	80	.60
14C5	.80	81	.60
14C7	.80	82	.96
14E7	.80	83	.43
14H7	.80	84	1.40
14J7	.96	85	.80
14N7	.96	89	.80
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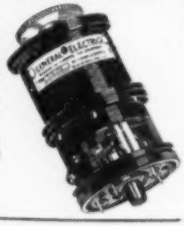

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For simple mounting, the 1N54 pigtails are soldered to a 2-lug insulated terminal strip mounted near the coil. The r.f. bypass condenser, C_3, is mounted near the 1N54. Load resistor R_1 is mounted on the audio amplifier strip near the first CK-703.

Hookup wire leads from the amplifier strip and battery pass through clearance holes in the chassis to reach under-chassis contact points. A stiff, bare lead extends from the tuning condenser stator lug through a large chassis clearance hole to the coil, L_2, below the chassis.

Testing and Alignment

Do not connect the battery until all connections in the circuit have been checked and found to be correct. After verification, connect the battery, plug in the high-impedance headphones, and throw the "On-Off" switch to "On." A gentle rushing sound should be heard, due to the inherent noise level of the crystal triodes, but there should be no oscillation nor singing. If there is oscillation, it will be necessary to re-run critical leads and possibly to orient the transformers to prevent the feedback.

A modulated r.f. signal generator may then be connected to the antenna and ground leads of the receiver and the dial calibrated at fixed broadcast band points in the usual manner. Use the signal in the headphones to indicate resonant points, or connect a high-resistance a.c. voltmeter in parallel with the headphones for visual indication. If a manufactured broadcast dial is used, line-up first at the top of the band (1600 kc.) and bend the outside plates of the tuning condenser to make the other frequencies coincide with the dial graduations.

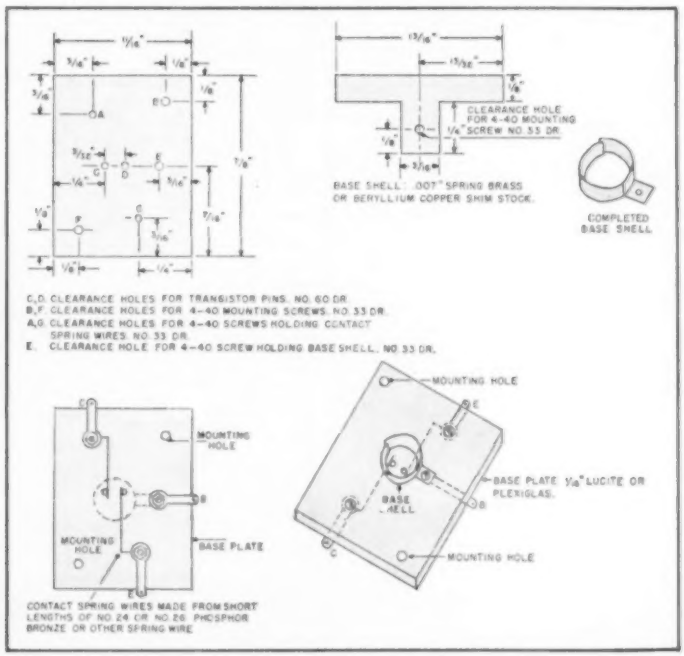
The noise level of the crystal triodes is somewhat higher than with comparable triodes in the same circuit, but is not objectionable in this arrangement. In the absence of a signal, a soft steady hiss will be heard.

Current drain of the amplifier is low and the battery consequently will give long service. However, the receiver should be switched off whenever it is not in use. This will prolong the life of the battery and of the crystal triodes as well. The set should not be left connected to the outside antenna during a thunderstorm unless an efficient lightning arrestor is attached.

No data is available at this writing regarding transistor life. The crystal triode is not yet old enough to have undergone prolonged life tests. However, it seems reasonable to expect life comparable to that of germanium diodes which presently are guaranteed up to 5000 hours.

The little receiver shown in this article is only an example of successful crystal triode application. The author does not intend to imply that this is the ultimate by any means. Certainly, a much smaller set could be built and a smaller battery of the hearing aid type could be employed. Higher power output can be obtained by using 4

Fig. 8. Construction details of transistor socket. The terminal markings (E, C, and B) indicated on both of the lower drawings refer to the symbols given in Fig. 5A.



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transistors in push-pull parallel in the output stage. A crystal triode r.f. amplifier might be added. An individual experimenter may prefer to employ fixed emitter bias, possibly derived from a "lower than ground" point on a voltage divider across the battery. Many applications, other than receivers and audio amplifiers, will undoubtedly occur to the reader. —30—

ANTENNA FOR THE SWL

By CHARLES KUNDE

DESPITE the large number of short-wave listeners currently pursuing their hobby there is surprisingly little data on suitable antennas available for the SWL. The usual operating manual accompanying a short-wave receiver devotes a few lines to the antenna problem and lets it go at that. Books on antennas devote a major portion of their space on transmitting antennas with maybe a footnote indicating that these antennas may also be used for reception on that particular wavelength.

What SWL wants to go to a great expense or a lot of trouble to set up an elegant beam cut for ten meters when he can have more fun listening to all the bands? When the band for which his antenna is cut starts to fade the results obtainable on other bands are not going to be too good either.

Thus, it appears that to get the utmost satisfaction from his receiver he will have to plan on a number of antennas that will come close to giving good response in a wider group of bands, with a minimum amount of labor and expense.

Employing for the purpose a low-priced modern short-wave receiver (S-38), the writer has found that by having a switching arrangement that is simple to make and by installing three very ordinary antennas he could get excellent results and interesting activity most of the time. None of the antennas require much labor or cash.

Antenna number one is a vertical rod which may be anywhere from six to twenty feet high. Antenna number two is a fourteen foot, seven inch length of 300 ohm transmission line used as a folded dipole and covering the ten meter band. The third antenna is a straight wire from forty to sixty feet in length which may be anything from bell wire to outdoor rubber-covered wire.

The average clothes closet or back porch will easily house the vertical, with any kind of wire running to the switchboard. The 300 ohm transmission line dipole will be fully concealed under a rug or hidden behind a picture molding. The long straight wire can be run from the front window to the back window or stretched along the floor somewhere. If the SWL has access to an attic or a roof, the job will, of course, be much neater.

The lead-ins from these simple antennas are then run to a main switchboard which is equipped with three d.p.d.t. switches mounted on masonite and wired or fastened in any acceptable manner.

The use of this antenna will provide an interesting study on the effects secured by going from one antenna to another at various stages of band response. In addition the short-wave log should show a nice increase in listings.

—30—

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"TELEVISION SERVICING FOR RADIO MEN" by H. P. Manly. Published by *Frederick J. Drake & Co.*, Wilmette, Illinois. 406 pages. Price $4.00.

This is a practical elementary text written for the radio technician who wishes to add television to the services rendered by his shop.

The author has assumed that his reader is familiar with the elementary principles of radio, the technique of servicing AM receivers, and the various types of test instruments used in such work. Other than these three assumptions the author takes nothing for granted. He starts his discussion with the picture tube and progresses painstakingly through television receiver circuits.

There are chapters on the television signal, the r.f. section, the video i.f. amplifier, the video detector, and the video amplifier as well as a discussion of the instruments used for alignment. Other chapters discuss the alignment of video i.f. and traps, the sound section and its alignment, front-end alignment, intercarrier sound, picture tube controls, signal input to the picture tube, the sync section, sweep oscillators, automatic control of sweep frequency, sweep amplifiers and controls, magnetic deflection amplifiers, television power supplies, and trouble-shooting with test patterns.

The book is well-written, the language clear and straightforward. Persons with a basic working knowledge of radio should experience no difficulty in grasping the subject matter as presented in this text. The book is prepared as a self-help manual but could be equally well adapted to classroom instruction. The text material is lavishly illustrated with diagrams and photographs.

* * *

"SATURATING CORE DEVICES" by Leonard R. Crow. Published by *The Scientific Book Publishing Co.*, Vincennes, Indiana. 367 pages.

This book, which has been designed as a handbook for students at the elementary electrical engineering level, is intended as an introduction to this vast subject rather than an all-inclusive text.

According to the author his purpose was to offer a collection of simplified descriptions of saturable core devices and their applications. This purpose has been admirably achieved. The book is divided into twelve chapters and two appendices. The author discusses in some detail such subjects as the fundamentals of saturable-core reactor devices, applications and modifications of d.c. controlled saturable-core reactors in non-electronic applications, saturable-core reactor applications involving special and ad-

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The generous use of diagrams and charts adds appreciably to the value and easy understandability of this text. The book serves its avowed purpose as a springboard to further study adequately and should find wide acceptance among engineering students and experimenters.

* * *

"MODERN OSCILLOSCOPES AND THEIR USES" by Jacob H. Ruiter, Jr. Published by *Murray Hill Books, Inc.*, New York. 318 pages. Price $6.00.

There has long been a demand for a book which explains, in simple terms, the operation of an oscilloscope. From all indications Mr. Ruiter, due to his familiarity with the field, has come up with the answer to the problem in this book.

The text is written for the electronics student, the radio technician, and the repairman with a background of general physics, however it should prove useful to anyone who uses oscilloscopes in his work. Written in a clear and succinct style it can be easily understood by anyone with elementary electronics training.

Although written for a diversified audience the text is comprehensive to the point that one feels all of the fundamentals of the oscilloscope and its uses have been fully covered.

The oscilloscope, its application, its construction, and operation are thoroughly covered. Considerable space has been devoted to a history of the instrument, the development of the cathode-ray tube, fundamentals of cathode-ray tube operation, and a description of a modern CR tube. The uses of the oscilloscope in AM, FM, and television servicing are covered completely. A chapter on photographing cathode-ray patterns is particularly valuable to those interested in retaining a permanent record of their investigations. —30—

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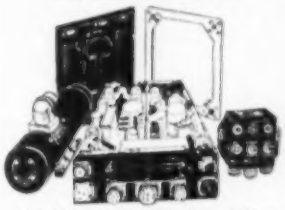

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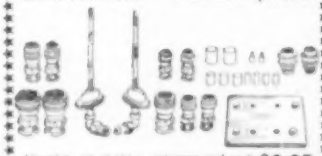

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THE Federal Communications Commission has announced (Public Notice 42642) that the ban imposed on some foreign ham contacts (Public Notice 41636) as reported on page 107 of the December issue of RADIO & TELEVISION NEWS has been removed.

The notice lifting the restriction advises that "amateurs and all others concerned are hereby authorized by the Commission to disregard, until further notice, the Commission's Public Notice (41636) dated October 13, 1949."

The original notice banned contacts with amateurs in the following countries: Austria, Burma, French Settlements in Oceania, Greece, Indo-China, Indonesia, Iran, Israel, Lebanon, Madagascar and dependencies, Mauritius, Netherlands Antilles, Siam, St. Pierre and Miquelon, and Togoland.

—30—

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—30—

ERRATUM

In the circuit diagram shown in connection with the article "A Wide Range Equalizing Amplifier" by Harry R. Hyder, appearing on page 53 of the October issue, a condenser necessary to the proper operation of the unit has been inadvertently omitted. There should be a .1 mfd., 400 v. condenser inserted in the circuit just before the resistor R, but after R.

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ADVERTISERS	PAGE
Acorn Electronics Corp.	152
Adson Radio & Electronics Co.	122
Allied Radio Corp.	9, 104
Almo Radio Co.	158
Altec Lansing Corporation	70
American Radio Institute	134
Amplifier Corp. of America	137
Approved Electronic Inst., Corp.	134
Arrow Sales, Inc.	145
Ashe Radio Co., Walter	100, 157
Associated Television Company	148
Audak Company	158
Baltimore Technical Institute	148
Bell Telephone Laboratories	99
Bliss Electrical School	96
Brook Electronics, Inc.	161
Brush Development Company, The	10
Buffalo Radio Supply	97
Burstein-Applebee Co.	151
C & H Sales Co.	148
Candler System	158
Cannon Electric Development Company	82
Capitol Radio Engineering Institute	95, 149
Centralab, Division of Globe-Union, Inc.	90, 91
Certified Television Laboratories	148, 152
Channel Master Corp.	26, 27
Chelsea Television Center, Inc.	149
Cinex, Inc.	145
Cleveland Institute of Radio Electronics	5
Clippard Instrument Laboratory, Inc.	159
Coastal Aviation Corporation	156
Columbia Electronic Sales	148
Comet Electronic Sales Co.	145
Communications Equipment Company	144
Components Supply Co.	144
Coyne Electrical, Radio & Television School	92, 142
DeForest's Training, Inc.	7
Dow Trading Co.	158
Drake & Co., Frederick J.	156
Edlie Electronics, Inc.	98
Electro Devices Incorporated	120
Electro-Technical Industries	150
Electro-Voice Inc.	103
Electronic Instrument Co., Inc.	96, 143, 148, 3rd Cover
Electronic Supplies	146
Electronics Institute, Inc.	148
Emmons Radio Supply	148
Espey Manufacturing Company, Inc.	144
Fair Radio Sales	127
Federated Purchaser, Incorporated	160
Feiler Engineering Co.	139, 155
Franklin-Ellis Co.	153
G. L. Electronics	156
Garson Industries	156
General Cement Mfg. Co.	132
General Electric Company	6, 69
General Electronic Distributing Co.	87
General Test Equipment	154
Goodheart, R. E.	156
Gould Green	159
Greentee Tool Co.	161
Greylin Co., The	96
Greylock Electronics Supply Co.	152
Harvey Radio Company, Inc.	86
Heath Company, The	74, 75, 76, 77, 78
Henry Radio Stores	160
Henshaw Radio Supply	142
Hollywood Sound Institute, Inc.	143
Hytron Radio and Electronics Corp.	15
Indiana Technical College	154
Instant Tool Corporation	146
Instructograph Company	152
Instrument Associates	154
Jensen Manufacturing Company	13
Klein, Manuel	150

ADVERTISERS	PAGE
Lafayette Radio	84
LaPointe Plascomold Corp.	89
Lectronic Research Labs.	156
Leotone Radio Co.	144
Liberty Electronics, Inc.	153
Long Island Radio Co.	156
MacMillan Co., The	101
Magnecord, Inc.	102
Mallory & Co., Inc., P. R.	4th Cover
Market Radio Stores	160
Maspeth Telephone & Radio Corporation	142
Mass. Radio School	150
Meissner Mfg., Division Maguire Ind., Inc.	133
Merit Coil & Transformer Corp.	24
Midwest Radio & Television Corp.	29
Milwaukee School of Engineering	145
Mosley Electronic Specialties	122
Murray Hill Books, Inc.	24, 107
McConnell's	138, 143
McGee Radio Company	85, 94, 95
National Radio Institute	3
National Schools	11
Newark Surplus Materials Co.	150
Norman Radio Distributors, Inc.	138
Northwestern Vocational Inst.	160
Offenbach & Reimus Co.	135
Onan & Sons, Inc., D. W.	152
Opad-Green Company	125
Owl Radio Tube Company	134
Peak Electronics Co.	105
Penn Boiler & Burner Mfg. Corp.	146
Phoenix Electronics, Inc.	154
Photocon Sales	129
Plastics & Electronics Company	152
Platt Electronics Corp.	147
Poly-Tech	158
Potter Radio Co.	161
Precision Electronics, Inc.	140
Premax Products	139
Premier Radio Tube Company	124
Progressive Electronics Co.	140
Pyramid Electric Company	22
Quam-Nichols Co.	133
RCA Institutes, Inc.	145
R & M Radio Company	131
R & T Electronics Company, Inc.	152
Racon Electric Co., Inc.	148
Radio Apparatus Corp.	147
Radio Coin Matic	134
Radio Corporation of America	30, 2nd Cover
Radio Craftsmen Incorporated, The	155
Radio Ham Shack Inc.	160
Radio Supply & Engineering Co., Inc.	142
Radionic Equipment Corporation	128
Rauland Corporation, The	25
Reeves Soundcraft Corp.	139
Robin Hood Co., The	142
Rose Company, The	146
Sams & Co., Inc., Howard W.	20
Sangamo Electric Company	28
Schott Co., Walter L.	144
Sewes Radio, Inc.	128
Simpson Electric Company	17
Simpson Manufacturing Co., Inc., Mark	149
Sonotone	140
Sovereign Television Co.	138
Spartan School of Radio and Electronics	129
Sprague Products Co.	18
Sprayberry Academy of Radio	19
Stahl, Inc., Michael	152
Standard Transformer Corporation	143
Suffolk Television Agency	145
Sun Radio and Electronics Company, Inc.	146
Sun Radio of Washington, D. C.	94
Supreme Publications	132
Sutton's Wholesale Electronics, Bill	148
Sylvania Electric Products Inc.	23

ADVERTISERS	PAGE
TAB	102
Telex	122
Telrex, Inc.	80
Thordarson Electric Manufacturing Division Maguire Industries, Inc.	100
Transvision, Inc.	14
Tri-State College	157
Triplett Electrical Instrument Company	12
University Loudspeakers Inc.	125
V & H Radio & Electronics Supply	153
Valparaiso Technical Institute	139
Van Nostrand Company, Inc., D.	112
Ward Leonard Electric Co.	96
Ward Products Corporation	21
Warren Distributors	114
Weller Manufacturing Company	8
Wells Sales, Inc.	93
Wholesale Radio Parts Co., Inc.	144
Workshop Associates, Inc., The	106
World Radio Laboratories Incorporated	147
YMCA Trade & Tech. School	148

NEW TUBES FOR TV AND FM

GENERAL Electric Company has announced production on two new electronic tubes which reduce the number of tubes and circuit elements required for FM and television receivers.

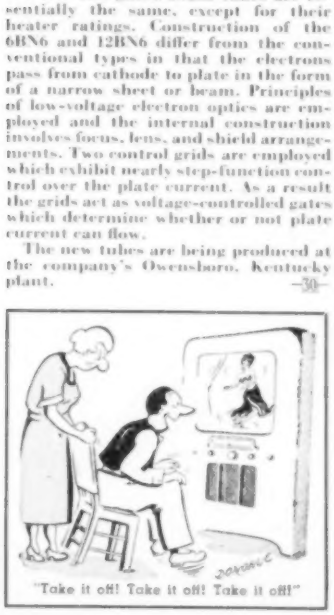
Each of the tubes (known as the 6BN6 and 12BN6) is designed to operate as a combined limiter and FM discriminator in an improved and simplified FM detection circuit. According to the company some of the potential applications of each tube include use in limiter circuits, sync clipper circuits, square-wave generators, frequency multipliers, and phase measuring devices.

The tubes also simplify alignment in television sets and eliminate the need for special transformers. Use of the tubes in television sets is said to provide good AM rejection, including exceptional rejection of pulse noise owing to absence of time constants.

These two gated-beam tubes are essentially the same, except for their heater ratings. Construction of the 6BN6 and 12BN6 differ from the conventional types in that the electrons pass from cathode to plate in the form of a narrow sheet or beam. Principles of low-voltage electron optics are employed and the internal construction involves focus, lens, and shield arrangements. Two control grids are employed which exhibit nearly step-function control over the plate current. As a result the grids act as voltage-controlled gates which determine whether or not plate current can flow.

The new tubes are being produced at the company's Owensboro, Kentucky plant.

—30—



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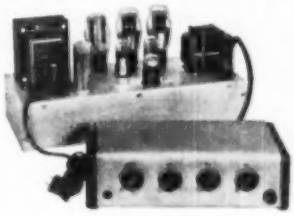

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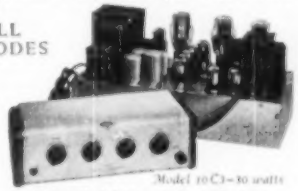

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1U5	35W4	6BA6	6AQ6	117Z3
3A4	35B5	6BE6	6C4	19T8
1B5	50B5	6AT6	6X4	6BJ6
3V4	12AT7	6AL5	6W4	6BA7
3Q4	12AU7	6AQ5	6AG5	6BJ6
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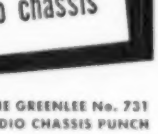

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13.52	330	1155	2250	8500	29500
14.2	340	1162	2300	8700	29990
14.28	350	1175	2400	8770	30000
14.5	360	1200	2418	9000	30600
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31.5	426.9	1510	2860	10900	43000
37	427	1518	2870	10936	45000
40	440	1800	2900	11000	47000
45	450	1640	3000	11400	47500
50	452	1646	3100	11500	48000
51.78	460	1650	3163	11690	48660
55	470	1670	3250	12000	49000
56.7	475	1680	3290	12500	50000
60	478	1710	3333	12800	52000
61	480	1712	3384	13000	54000
68	487	1740	3500	13100	56000
74	500	1770	3500	13500	57065
75	518	1800	3700	13550	58333
80	520	1818	3730	13600	60000
81.4	525	1830	3760	14000	61430
88	540	1885	4000	14250	62000
89.8	550	1892	4030	14400	64000
90	575	1894	4200	14500	65000
95	580	1895	4220	14550	66000
100	586	1896	4280	14800	66650
101	600	1897	4300	15000	67500
105	612	1898	4314	15500	68000
105.7	628	1899	4440	16500	70000
107	633	1900	4444	16800	72000
120	640	1901	4500	17000	73500
121.2	641	1902	4720	17500	75000
125	645	1903	4750	17977	80000
130	649	1904	4850	18000	82000
135	650	1905	4885	18300	84000
140	657	1906	4900	18380	85000
147.5	661	1907	5000	18500	86750
150	670	1908	5100	18800	88000
160	673	1909	5210	19000	90000
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179					

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120000	186600	268000	402000	650000	
125000	190000	270000	420000	654000	
130000	196000	275000	422000	660000	
135000	200000	294000	425000	930000	
140000	201000	300000	450000	700000	
141000	205000	307500	458000	718500	
145000	210000	311000	470000	750000	
147000	215000	314000	478000	761300	
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1.3	1.8	3.855	6.5	11.5	12
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1T4	6AK5	6BF6	6T8	12BA7	35C5
1U4	6AL5	6BG6G	6X4	12BE6	35W4
1U5	6AQ5	6BJ6	6X5	12C8	50B5
3A4	6AT6	6C4	7C4 1203A	12H6	50C5
3Q4	6AR8	6J6	12A6	12S8GT	83
3S4	6AU6	6P5GT	12AL5	12SH7	117Z3
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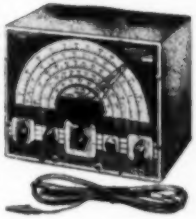

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• Crystal marker oscillator with variable amplitude. • Covers all TV and FM alignment frequencies between 500 kc. and 228 mc. • Sweep-width variable from 0-30 mc. with mechanical inductive sweep. • Extremely wide sweepwidth allows gain comparison of adjacent RF TV Channels. • Provides for injection of external signal generator marker. • Phasing control included. • Large, easy-to-read dial is directly calibrated in frequencies. Comes complete with all tubes (including new, high-frequency miniature types): 6X5GT, 12AU7, two 6C4's. Crystal not included. 10"x8"x8½".

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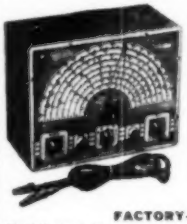
Model 360. Ready to use Sweep Signal Generator. See it at your local jobber!



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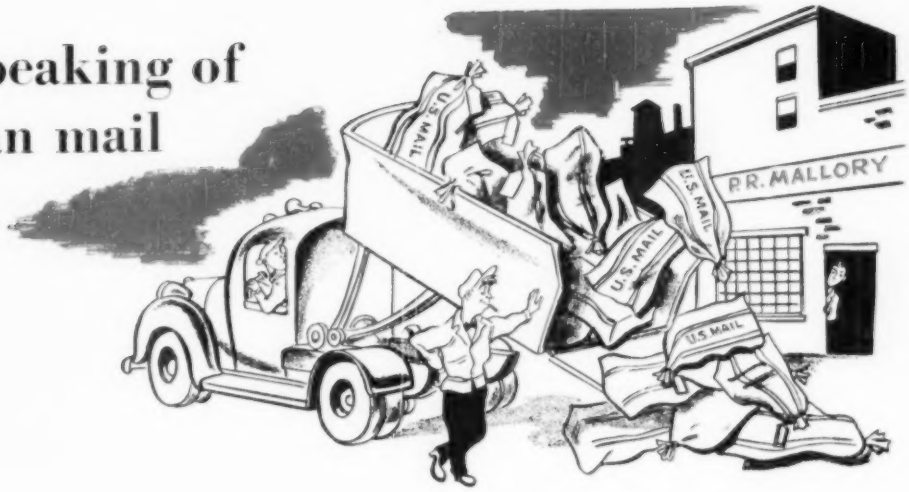

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Run your eyes down the quotes below. They are convincing proof that the Mallory Midgetrol is a star performer with servicemen everywhere.

FAN MAIL FROM SERVICEMEN WHO KNOW!*

- "The Midgetrol is a life-saver in the radio repair business!"
- "The new Mallory Midgetrol is the handiest control I have seen."
- "I have been in the servicing game for 17 years now and this is really the first universal control I have ever seen."
- "Your many innovations make this the outstanding control."
- "I like it very much . . . the small size, the better shaft and the improved switch are all very good."
- "It is sure a time and space saver."
- "Thanks for Midgetrol. It's a sensation!"

*Actual quotations from a few of hundreds of unsolicited letters from servicemen.

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*Reg. U.S. Pat. Off.

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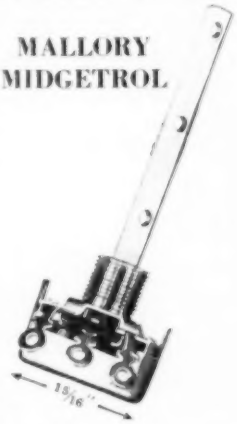
MALLORY MIDGETROL



- *Fastest of all to install*
- *Saves time*
- *Saves trouble*
- *Saves money*
- *Easiest switch to attach*
- *Eliminates sawing and filing*
- *15/16" size fits all sets*

See your Mallory distributor today!